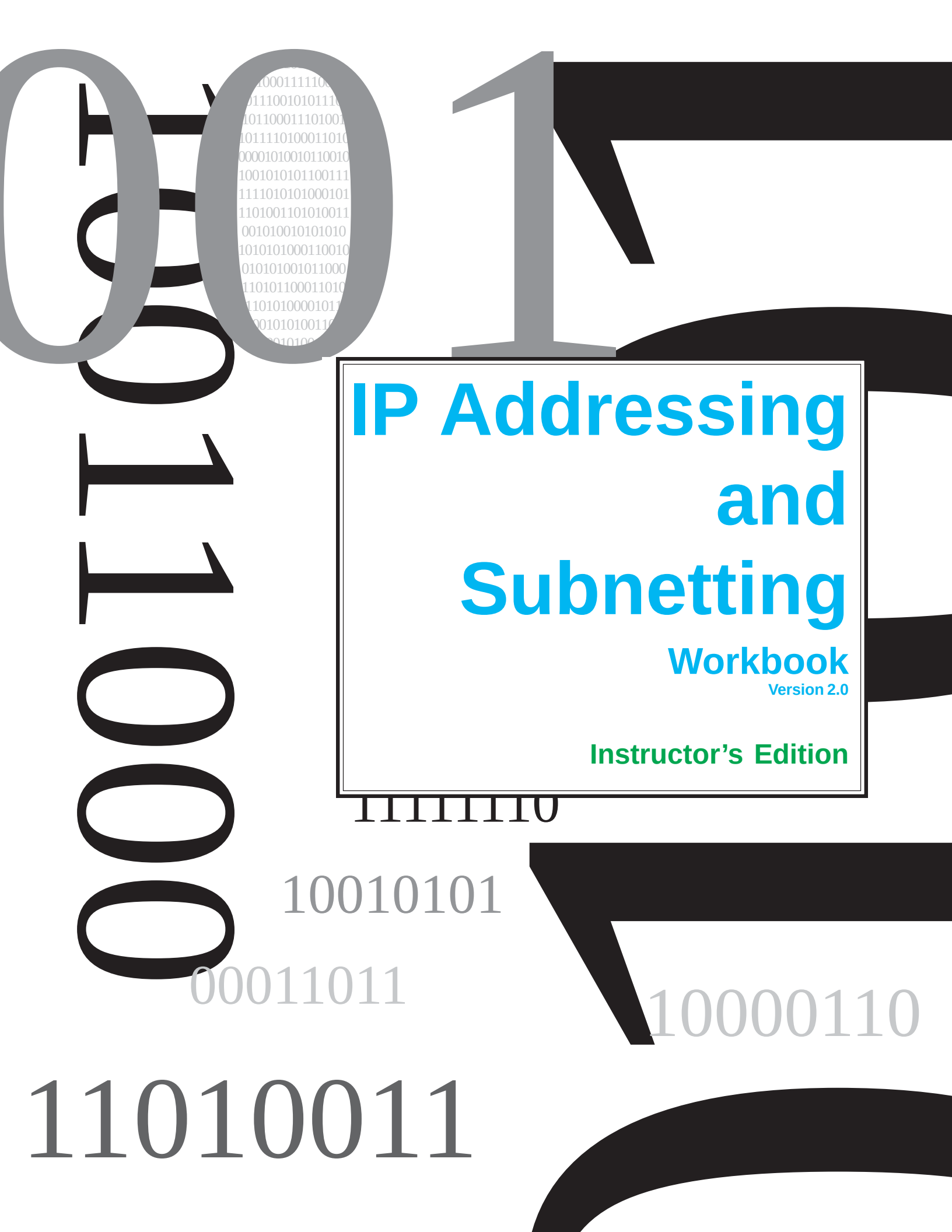
IP Addressing and Subnetting
Workbook
Version 2.0
Instructor's Edition

IP Address Classes

Class A	1 – 127	(Network 127 is reserved for loopback and internal testing) Leading bit pattern	0	00000000.00000000.00000000.00000000 Network . Host . Host . Host
Class B	128 – 191	Leading bit pattern	10	10000000.00000000.00000000.00000000 Network . Network . Host . Host
Class C	192 – 223	Leading bit pattern	110	11000000.00000000.00000000.00000000 Network . Network . Network . Host
Class D	224 – 239	(Reserved for multicast)		
Class E	240 – 255	(Reserved for experimental, used for research)		

Private Address Space

Class A	10.0.0.0 to 10.255.255.255
Class B	172.16.0.0 to 172.31.255.255
Class C	192.168.0.0 to 192.168.255.255

Default Subnet Masks

Class A	255.0.0.0
Class B	255.255.0.0
Class C	255.255.255.0

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and to everyone who has sent in suggestions to improve the series.

Workbooks included in the series:

IP Addressing and Subnetting Workbooks
ACLs - Access Lists Workbooks
VLSM Variable-Length Subnet Mask Workbooks

Instructors (and anyone else for that matter) please do not post the Instructors version on public websites. When you do this you are giving everyone else worldwide the answers. Yes, students look for answers this way. It also discourages others; myself included, from posting high quality materials.

Binary To Decimal Conversion

128	64	32	16	8	4	2	1	Answers
1	0	0	1	0	0	1	0	146
0	1	1	1	0	1	1	1	119
1	1	1	1	1	1	1	1	255
1	1	0	0	0	1	0	1	197
1	1	1	1	0	1	1	0	246
0	0	0	1	0	0	1	1	19
1	0	0	0	0	0	0	1	129
0	0	1	1	0	0	0	1	49
0	1	1	1	1	0	0	0	120
1	1	1	1	0	0	0	0	240
0	0	1	1	1	0	1	1	59
0	0	0	0	0	1	1	1	7
						00011011		27
						10101010		170
						01101111		111
						11111000		248
						00100000		32
						01010101		85
						00111110		62
						00000011		3
						11101101		237
						11000000		192

Scratch Area

128 64
16 32
2 16
146 4
2
1
119

Decimal To Binary Conversion

Use all 8 bits for each problem

128	64	32	16	8	4	2	1	= 255
1	1	1	0	1	1	1	0	238
0	0	1	0	0	0	1	0	34
0	1	1	1	1	0	1	1	123
0	0	1	1	0	0	1	0	50
1	1	1	1	1	1	1	1	255
1	1	0	0	1	0	0	0	200
0	0	0	0	1	0	1	0	10
1	0	0	0	1	0	1	0	138
0	0	0	0	0	0	0	1	1
0	0	0	0	1	1	0	1	13
1	1	1	1	1	0	1	0	250
0	1	1	0	1	0	1	1	107
1	1	1	0	0	0	0	0	224
0	1	1	1	0	0	1	0	114
1	1	0	0	0	0	0	0	192
1	0	1	0	1	1	0	0	172
0	1	1	0	0	1	0	0	100
0	1	1	1	0	1	1	1	119
0	0	1	1	1	0	0	1	57
0	1	1	0	0	0	1	0	98
1	0	1	1	0	0	1	1	179
0	0	0	0	0	0	1	0	2

Scratch Area

```
238
-128
 110
 -64
  46
 -32
  14
  -8
   6
  -4
   2
  -2
   0
```

```
34
-32
 2
-2
 0
```

Address Class Identification

Address	Class
10.250.1.1	A
150.10.15.0	B
192.14.2.0	C
148.17.9.1	B
193.42.1.1	C
126.8.156.0	A
220.200.23.1	C
230.230.45.58	D
177.100.18.4	B
119.18.45.0	A
249.240.80.78	E
199.155.77.56	C
117.89.56.45	A
215.45.45.0	C
199.200.15.0	C
95.0.21.90	A
33.0.0.0	A
158.98.80.0	B
219.21.56.0	C

Network & Host Identification

Circle the network portion of these addresses:

177.100.18.4

119.18.45.0

209.240.80.78

199.155.77.56

117.89.56.45

215.45.45.0

192.200.15.0

95.0.21.90

33.0.0.0

158.98.80.0

217.21.56.0

10.250.1.1

150.10.15.0

192.14.2.0

148.17.9.1

193.42.1.1

126.8.156.0

220.200.23.1

Circle the host portion of these addresses:

10.15.123.50

171.2.199.31

198.125.87.177

223.250.200.222

17.45.222.45

126.201.54.231

191.41.35.112

155.25.169.227

192.15.155.2

123.102.45.254

148.17.9.155

100.25.1.1

195.0.21.98

25.250.135.46

171.102.77.77

55.250.5.5

218.155.230.14

10.250.1.1

Network Addresses

Using the IP address and subnet mask shown write out the network address:

188.10.18.2 255.255.0.0	188 . 10 . 0 . 0
10.10.48.80 255.255.255.0	10 . 10 . 48 . 0
192.149.24.191 255.255.255.0	192 . 149 . 24 . 0
150.203.23.19 255.255.0.0	150 . 203 . 0 . 0
10.10.10.10 255.0.0.0	10 . 0 . 0 . 0
186.13.23.110 255.255.255.0	186 . 13 . 23 . 0
223.69.230.250 255.255.0.0	223 . 69 . 0 . 0
200.120.135.15 255.255.255.0	200 . 120 . 135 . 0
27.125.200.151 255.0.0.0	27 . 0 . 0 . 0
199.20.150.35 255.255.255.0	199 . 20 . 150 . 0
191.55.165.135 255.255.255.0	191 . 55 . 165 . 0
28.212.250.254 255.255.0.0	28 . 212 . 0 . 0

Host Addresses

Using the IP address and subnet mask shown write out the host address:

188.10.18.2
255.255.0.0 — 0 . 0 . 18 . 2

10.10.48.80
255.255.255.0 — 0 . 0 . 0 . 80

222.49.49.11
255.255.255.0 — 0 . 0 . 0 . 11

128.23.230.19
255.255.0.0 — 0 . 0 . 230 . 19

10.10.10.10
255.0.0.0 — 0 . 10 . 10 . 10

200.113.123.11
255.255.255.0 — 0 . 0 . 0 . 11

223.169.23.20
255.255.0.0 — 0 . 0 . 23 . 20

203.20.35.215
255.255.255.0 — 0 . 0 . 0 . 215

117.15.2.51
255.0.0.0 — 0 . 15 . 2 . 51

199.120.15.135
255.255.255.0 — 0 . 0 . 0 . 135

191.55.165.135
255.255.255.0 — 0 . 0 . 0 . 135

48.21.25.54
255.255.0.0 — 0 . 0 . 25 . 54

Default Subnet Masks

Write the correct default subnet mask for each of the following addresses:

177.100.18.4	255 . 255 . 0 . 0
119.18.45.0	255 . 0 . 0 . 0
191.249.234.191	255 . 255 . 0 . 0
223.23.223.109	255 . 255 . 255 . 0
10.10.250.1	255 . 0 . 0 . 0
126.123.23.1	255 . 0 . 0 . 0
223.69.230.250	255 . 255 . 255 . 0
192.12.35.105	255 . 255 . 255 . 0
77.251.200.51	255 . 0 . 0 . 0
189.210.50.1	255 . 255 . 0 . 0
88.45.65.35	255 . 0 . 0 . 0
128.212.250.254	255 . 255 . 0 . 0
193.100.77.83	255 . 255 . 255 . 0
125.125.250.1	255 . 0 . 0 . 0
1.1.10.50	255 . 0 . 0 . 0
220.90.130.45	255 . 255 . 255 . 0
134.125.34.9	255 . 255 . 0 . 0
95.250.91.99	255 . 0 . 0 . 0

ANDING With
Default subnet masks

Every IP address must be accompanied by a subnet mask. By now you should be able to look at an IP address and tell what class it is. Unfortunately your computer doesn't think that way. For your computer to determine the network and subnet portion of an IP address it must "AND" the IP address with the subnet mask.

Default Subnet Masks:

Class A	255.0.0.0
Class B	255.255.0.0
Class C	255.255.255.0

ANDING Equations:

1 AND 1 = 1
1 AND 0 = 0
0 AND 1 = 0
0 AND 0 = 0

Sample:

What you see...

IP Address: 192 . 100 . 10 . 33

What you can figure out in your head...

Address Class:	C
Network Portion:	**192 . 100 . 10** . 33
Host Portion:	192 . 100 . 10 . **33**

In order for you computer to get the same information it must AND the IP address with the subnet mask in binary.

	Network	Host	
IP Address:	1 1 0 0 0 0 0 0 . 0 1 1 0 0 1 0 0 . 0 0 0 0 1 0 1 0	0 0 1 0 0 0 0 1	(192 . 100 . 10 . 33)
Default Subnet Mask:	1 1 1 1 1 1 1 1 . 0 1 1 1 1 1 1 1 . 1 1 1 1 1 1 1 1	0 0 0 0 0 0 0 0	(255 . 255 . 255 . 0)
AND:	1 1 0 0 0 0 0 0 . 0 1 1 0 0 1 0 0 . 0 0 0 0 1 0 1 0	0 0 0 0 0 0 0 0	(192 . 100 . 10 . 0)

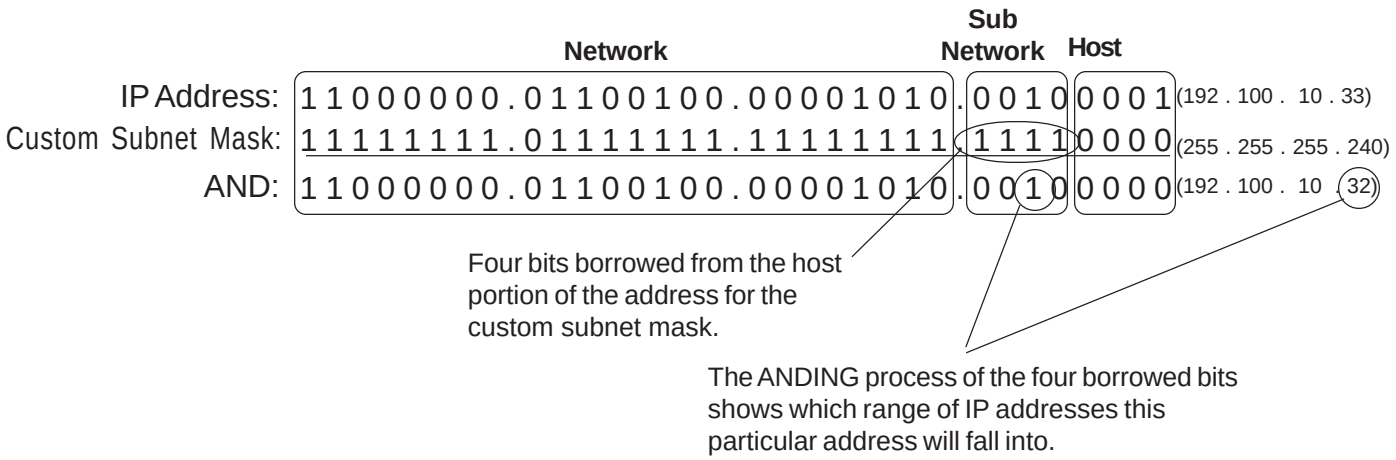
ANDING with the default subnet mask allows your computer to figure out the network portion of the address.

ANDING With
Custom subnet masks

When you take a single network such as 192.100.10.0 and divide it into five smaller networks (192.100.10.16, 192.100.10.32, 192.100.10.48, 192.100.10.64, 192.100.10.80) the outside world still sees the network as 192.100.10.0, but the internal computers and routers see five smaller subnetworks. Each independent of the other. This can only be accomplished by using a custom subnet mask. A custom subnet mask borrows bits from the host portion of the address to create a subnetwork address between the network and host portions of an IP address. In this example each range has 14 usable addresses in it. The computer must still AND the IP address against the custom subnet mask to see what the network portion is and which subnetwork it belongs to.

IP Address: 192 . 100 . 10 . 0
Custom Subnet Mask: 255.255.255.240

Address Ranges:
192.10.10.0 to 192.100.10.15
192.100.10.16 to 192.100.10.31
192.100.10.32 to 192.100.10.47 (Range in the sample below)
192.100.10.48 to 192.100.10.63
192.100.10.64 to 192.100.10.79
192.100.10.80 to 192.100.10.95
192.100.10.96 to 192.100.10.111
192.100.10.112 to 192.100.10.127
192.100.10.128 to 192.100.10.143
192.100.10.144 to 192.100.10.159
192.100.10.160 to 192.100.10.175
192.100.10.176 to 192.100.10.191
192.100.10.192 to 192.100.10.207
192.100.10.208 to 192.100.10.223
192.100.10.224 to 192.100.10.239
192.100.10.240 to 192.100.10.255



In the next set of problems you will determine the necessary information to determine the correct subnet mask for a variety of IP addresses.

How to determine the number of subnets and the number of hosts per subnet

Two formulas can provide this basic information:

Number of subnets = 2^s (Second subnet formula: **Number of subnets = 2^s - 2**)

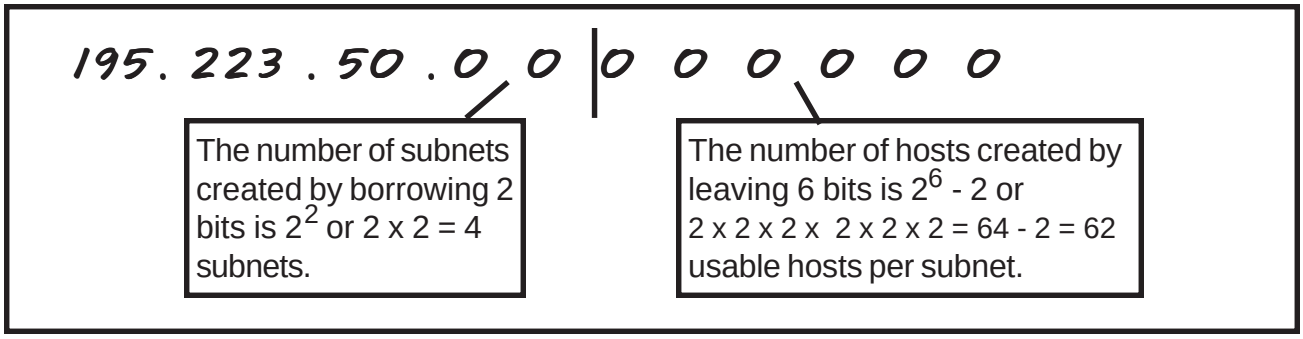
Number of hosts per subnet = 2^h - 2

Both formulas calculate the number of hosts or subnets based on the number of binary bits used. For example if you borrow three bits from the host portion of the address use the *number of subnets* formula to determine the total number of subnets gained by borrowing the three bits. This would be 2^3 or 2 x 2 x 2 = 8 subnets

To determine the number of hosts per subnet you would take the number of binary bits used in the host portion and apply this to the *number of hosts per subnet* formula If five bits are in the host portion of the address this would be 2^5 or 2 x 2 x 2 x 2 x 2 = 32 hosts.

When dealing with the *number of hosts per subnet* you have to subtract two addresses from the range. The first address in every range is the subnet number. The last address in every range is the broadcast address. These two addresses cannot be assigned to any device in the network which is why you have to subtract two addresses to find the number of usable addresses in each range.

For example if two bits are borrowed for the network portion of the address you can easily determine the number of subnets and hosts per subnets using the two formulas.



What about that second subnet formula:

Number of subnets = 2^s - 2

In some instances the first and last subnet range of addresses are reserved. This is similar to the first and last host addresses in each range of addreses.

The first range of addresses is the ***zero subnet***. The subnet number for the *zero subnet* is also the subnet number for the classful subnet address.

The last range of addresses is the ***broadcast subnet***. The broadcast address for the last subnet in *the broadcast subnet* is the same as the classful broadcast address.

Class C Address unsubnetted:

195. 223 . 50 . 0

195.223.50.0 to 195.223.50.255

Notice that the subnet and broadcast addresses match.

Class C Address subnetted (2 bits borrowed):

195. 223 . 50 . 0 0 | 0 0 0 0 0 0

(Invalid range) (0) 195.223.50.0 to 195.223.50.63
(1) 195.223.50.64 to 195.223.50.127
(2) 195.223.50.128 to 195.223.50.191
(Invalid range) (3) 195.223.50.192 to 195.223.50.255

The primary reason the the zero and broadcast subnets were not used had to do pirmarily with the broadcast addresses. If you send a broadcast to 195.223.255 are you sending it to all 255 addresses in the classful C address or just the 62 usable addresses in the broadcast range?

The **CCNA** and **CCENT** certification exams may have questions which will require you to determine which formula to use, and whehter or not you can use the first and last subnets. Use the chart below to help decide.

When to use which formula to determine the number of subnets	
Use the $2^S - 2$ formula and **don't use** the zero and broadcast ranges if...	Use the 2^S formula and **use** the zero and broadcast ranges if...
Classful routing is used	Classless routing or VLSM is used
RIP version 1 is used	RIP version 2, EIGRP, or OSPF is used
The ***no ip subnet zero*** command is configured on your router	The ***ip subnet zero*** command is configured on your router (default setting)
	No other clues are given

Bottom line for the CCNA exams; if a question does not give you any clues as to whether or not to allow these two subnets, assume you can use them.

This workbook has you use the number of subnets = 2^S formula.

Custom Subnet Masks

Problem 1

Number of needed subnets **14**
Number of needed usable hosts **14**
Network Address **192.10.10.0**

Address class C

Default subnet mask 255 . 255 . 255 . 0

Custom subnet mask 255 . 255 . 255 . 240

Total number of subnets 16

Total number of host addresses 16

Number of usable addresses 14

Number of bits borrowed 4

Show your work for Problem 1 in the space below.

	256	128	64	32	16	8	4	2	– Number of Hosts
Number of Subnets –	2	4	8	16	32	64	128	256	
	128	64	32	16	8	4	2	1	– Binary values
192 . 10 . 10 .	0	0	0	0	0	0	0	0	

Add the binary value numbers to the left of the line to create the custom subnet mask.

128
64
32
+16
240

16 Observe the total number of hosts.
−2 Subtract 2 for the number of usable hosts.
14

Custom Subnet Masks

Problem 2

Number of needed subnets **1000**
Number of needed usable hosts **60**
Network Address **165.100.0.0**

Address class ___B___

Default subnet mask ___255 . 255 . 0 . 0___

Custom subnet mask ___255 . 255 . 255 . 192___

Total number of subnets ___1,024___

Total number of host addresses ___64___

Number of usable addresses ___62___

Number of bits borrowed ___10___

Show your work for <u>Problem 2</u> in the space below.

Number of Hosts →	65,536	32,768	16,384	8,192	4,096	2,048	1,024	512	.	256	128	64	32	16	8	4	2
Number of Subnets →	2	4	8	16	32	64	128	256	.	512	1024	2048	4,096	8,192	16,384	32,768	65,536
Binary values →	128	64	32	16	8	4	2	1	.	128	64	32	16	8	4	2	1
165 . 100 .	0	0	0	0	0	0	0	0	.	0	0	0	0	0	0	0	0

Add the binary value numbers to the left of the line to create the custom subnet mask.

128
64
32
16
8
4
2
+1
255

128
+64
192

64 Observe the total number of hosts.
−2 Subtract 2 for the number of usable hosts.
62

Custom Subnet Masks

Problem 3

/26 indicates the total number of bits used for the network and subnetwork portion of the address. All bits remaining belong to the host portion of the address.

Network Address **148.75.0.0 /26**

Address class B

Default subnet mask 255 . 255 . 0 . 0

Custom subnet mask 255 . 255 . 255 . 192

Total number of subnets 1,024

Total number of host addresses 64

Number of usable addresses 62

Number of bits borrowed 10

Show your work for Problem 3 in the space below.

	65,536	32,768	16,384	8,192	4,096	2,048	1,024	512	. 256	128	64	32	16	8	4	2
Number of Hosts	–															
Number of Subnets	–	2	4	8	16	32	64	128	256.	512	1024	2048	4,096	8,192	16,384	32,768	65,536
Binary values	–	128	64	32	16	8	4	2	1 .	128	64	32	16	8	4	2	1
148 . 75 .		**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0 .**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

Add the binary value numbers to the left of the line to create the custom subnet mask.

128
64
32
16
8
4
2
+1
255

128
+64
192

1024
-2
1,022

Subtract 2 for the total number of subnets to get the usable number of subnets.

64 Observe the total number of hosts.

-2 Subtract 2 for the number of usable hosts.

62

Custom Subnet Masks

Problem 4

Number of needed subnets **6**
Number of needed usable hosts **30**
Network Address **195.85.8.0**

Address class C

Default subnet mask 255 . 255 . 255 . 0

Custom subnet mask 255 . 255 . 255 . 224

Total number of subnets 8

Total number of host addresses 32

Number of usable addresses 30

Number of bits borrowed 3

Show your work for Problem 5 in the space below.

	256	128	64	32	16	8	4	2	- Number of Hosts
Number of Subnets -	2	4	8	16	32	64	128	256	
	128	64	32	16	8	4	2	1	- Binary values
195 . 85 . 8 .	0	0	0	0	0	0	0	0	

128
64
+32
224

32
-2
30

8
-2
6

Custom Subnet Masks

Problem 5

Number of needed subnets **6**
Number of needed usable hosts **30**
Network Address **210.100.56.0**

Address class C

Default subnet mask 255 . 255 . 255 . 0

Custom subnet mask 255 . 255 . 255 . 224

Total number of subnets 8

Total number of host addresses 32

Number of usable addresses 30

Number of bits borrowed 3

Show your work for Problem 4 in the space below.

Number of Subnets		256	128	64	32	16	8	4	2		Number of Hosts
	-	2	4	8	16	32	64	128	256		
		128	64	32	16	8	4	2	1	-	Binary values
210 . 100 . 56 .		0	0	0	0	0	0	0	0		

128
64
+32
224

8
-2
6

32
-2
30

Custom Subnet Masks

Problem 6

Number of needed subnets **126**
Number of needed usable hosts **131,070**
Network Address **118.0.0.0**

Address class A

Default subnet mask 255 . 0 . 0 . 0

Custom subnet mask 255 . 254 . 0 . 0

Total number of subnets 128

Total number of host addresses 131,072

Number of usable addresses 131,070

Number of bits borrowed 7

Show your work for Problem 6 in the space below.

Number of Hosts	–			4,194,304	2097,152	1048,576	524,288	262,144	131,072		65,536	32,768	16,384	8,192	4,096	2048	1,024	512	.	256	128	64	32	16	8	4	2
Number of Subnets	–	2	4	8	16	32	64	128	256	.	512	1,024	2048	4096	8,192	16,384	32,768	65,536	.	131,072	262,144	524,288	1048,576	2097,152	4,194,304		
Binary values	–	128	64	32	16	8	4	2	1	.	128	64	32	16	8	4	2	1	.	128	64	32	16	8	4	2	1
118.		0	0	0	0	0	0	0	0	.	0	0	0	0	0	0	0	0	.	0	0	0	0	0	0	0	0

128
64
32
16
8
4
+2
254

128
−2
126

131,072
−2
131,070

Custom Subnet Masks

Problem 7

Number of needed subnets **2000**
Number of needed usable hosts **15**
Network Address **178.100.0.0**

Address class B

Default subnet mask 255 . 255 . 0 . 0

Custom subnet mask 255 . 255 . 255 . 224

Total number of subnets 2,048

Total number of host addresses 32

Number of usable addresses 30

Number of bits borrowed 11

Show your work for Problem 7 in the space below.

										.								
Number of Hosts	–	65,536	32,768	16,384	8,192	4,096	2,048	1,024	512	.	256	128	64	32	16	8	4	2
Number of Subnets	–	2	4	8	16	32	64	128	256	.	512	1024	2048	4,096	8,192	16,384	32,768	65,536
Binary values	–	128	64	32	16	8	4	2	1	.	128	64	32	16	8	4	2	1
178 . 100 .		0	0	0	0	0	0	0	0	.	0	0	0	0	0	0	0	0

128
64
32
16
8
4
2
+1
255

2,048
-2
2,046

32
-2
30

Custom Subnet Masks

Problem 8

Number of needed subnets **3**
Number of needed usable hosts **45**
Network Address **200.175.14.0**

Address class C

Default subnet mask 255 . 255 . 255 . 0

Custom subnet mask 255 . 255 . 255 . 192

Total number of subnets 4

Total number of host addresses 64

Number of usable addresses 62

Number of bits borrowed 2

Show your work for Problem 8 in the space below.

	256	128	64	32	16	8	4	2	- Number of Hosts
Number of Subnets -	2	4	8	16	32	64	128	256	
	128	64	32	16	8	4	2	1	- Binary values
200 . 175 . 14 .	0	0	0	0	0	0	0	0	

128 + 64 = 240

4 - 2 = 2

64 - 2 = 62

Custom Subnet Masks

Problem 9

Number of needed subnets **60**
Number of needed usable hosts **1,000**
Network Address **128.77.0.0**

Address class B

Default subnet mask 255 . 255 . 0 . 0

Custom subnet mask 255 . 255 . 252 . 0

Total number of subnets 64

Total number of host addresses 1,024

Number of usable addresses 1,022

Number of bits borrowed 6

Show your work for Problem 9 in the space below.

									.								
Number of Hosts –	65,536	32,768	16,384	8,192	4,096	2,048	1,024	512	.	256	128	64	32	16	8	4	2
Number of Subnets –	2	4	8	16	32	64	128	256.		512	1024	2048	4,096	8,192	16,384	32,768	65,536
Binary values –	128	64	32	16	8	4	2	1	.	128	64	32	16	8	4	2	1
128 . 77 .	0	0	0	0	0	0	0	0	.	0	0	0	0	0	0	0	0

128
64
32
16
8
+4
252

64
-2
62

1,024
-2
1,022

Custom Subnet Masks

Problem 10

Number of needed usable hosts **60**

Network Address **198.100.10.0**

Address class C

Default subnet mask 255 . 255 . 255 . 0

Custom subnet mask 255 . 255 . 255 . 192

Total number of subnets 4

Total number of host addresses 64

Number of usable addresses 62

Number of bits borrowed 2

Show your work for Problem 10 in the space below.

	256	128	64	32	16	8	4	2	– Number of Hosts
Number of Subnets –	2	4	8	16	32	64	128	256	
	128	64	32	16	8	4	2	1	– Binary values
198 . 100 . 10 .	0	0	0	0	0	0	0	0	

128 + 64 = 192

64 − 2 = 62

4 − 2 = 2

Custom Subnet Masks

Problem 11

Number of needed subnets **250**

Network Address **101.0.0.0**

Address class A

Default subnet mask 255 . 0 . 0 . 0

Custom subnet mask 255 . 255 . 0 . 0

Total number of subnets 256

Total number of host addresses 65,536

Number of usable addresses 65,534

Number of bits borrowed 8

Show your work for Problem 11 in the space below.

Number of Hosts –								4,194,304	2,097,152	1,048,576	524,288	262,144	131,072	65,536	32,768	16,384	8,192	4,096	2,048	1,024	512	.	256	128	64	32	16	8	4	2			
Number of Subnets –		2	4	8	16	32	64	128	256	512	1,024	2,048	4,096	8,192	16,384	32,768	65,536	.	131,072	262,144	524,288	1,048,576	2,097,152	4,194,304								
Binary values –	128	64	32	16	8	4	2	1	.	128	64	32	16	8	4	2	1	.	128	64	32	16	8	4	2	1						
	1	0	1	. 0	0	0	0	0	0	. 0	0	0	0	0	0	0	0	.	0	0	0	0	0	0	0	0						

128
64
32
16
8
4
2
+1
255

256
−2
254

65,536
−2
65,534

Custom Subnet Masks

Problem 12

Number of needed subnets **5**

Network Address **218.35.50.0**

Address class C

Default subnet mask 255 . 255 . 255 . 0

Custom subnet mask 255 . 255 . 255 . 224

Total number of subnets 8

Total number of host addresses 32

Number of usable addresses 30

Number of bits borrowed 3

Show your work for Problem 12 in the space below.

	256	128	64	32	16	8	4	2	– Number of Hosts
Number of Subnets –	2	4	8	16	32	64	128	256	
	128	64	32	16	8	4	2	1	– Binary values
218 . 35 . 50 .	0	0	0	0	0	0	0	0	

128
64
+32
224

64
−2
62

4
−2
2

Custom Subnet Masks

Problem 13

Number of needed usable hosts **25**

Network Address **218.35.50.0**

Address class C

Default subnet mask 255 . 255 . 255 . 0

Custom subnet mask 255 . 255 . 255 . 224

Total number of subnets 8

Total number of host addresses 32

Number of usable addresses 30

Number of bits borrowed 3

Show your work for Problem 13 in the space below.

	256	128	64	32	16	8	4	2	– Number of Hosts
Number of Subnets –	2	4	8	16	32	64	128	256	
	128	64	32	16	8	4	2	1	– Binary values
218 . 35 . 50 .	0	0	0	0	0	0	0	0	

128
64
+32
224

8
−2
6

32
−2
30

Custom Subnet Masks

Problem 14

Number of needed subnets **10**

Network Address **172.59.0.0**

Address class B

Default subnet mask 255 . 255 . 0 . 0

Custom subnet mask 255 . 255 . 240 . 0

Total number of subnets 16

Total number of host addresses 4,096

Number of usable addresses 4,094

Number of bits borrowed 4

Show your work for Problem 14 in the space below.

										.								
Number of Hosts →	65,536	32,768	16,384	8,192	4,096	2,048	1,024	512		.	256	128	64	32	16	8	4	2
Number of Subnets →	2	4	8	16	32	64	128	256		.	512	1024	2048	4,096	8,192	16,384	32,768	65,536
Binary values →	128	64	32	16	8	4	2	1		.	128	64	32	16	8	4	2	1
172 . 59 .	0	0	0	0	0	0	0	0		.	0	0	0	0	0	0	0	0

128
64
32
+16
240

16
-2
14

4,096
-2
4,094

Custom Subnet Masks

Problem 15

Number of needed usable hosts **50**

Network Address **172.59.0.0**

Address class B

Default subnet mask 255 . 255 . 0 . 0

Custom subnet mask 255 . 255 . 255 . 192

Total number of subnets 1,024

Total number of host addresses 64

Number of usable addresses 62

Number of bits borrowed 10

Show your work for Problem 15 in the space below.

Number of Hosts →	65,536	32,768	16,384	8,192	4096	2048	1,024	512	.	256	128	64	32	16	8	4	2	
Number of Subnets →	2	4	8	16	32	64	128	256	.	512	1024	2048	4,096	8,192	16,384	32,768	65,536	
Binary values →	128	64	32	16	8	4	2	1	.	128	64	32	16	8	4	2	1	
172 . 59 .	0	0	0	0	0	0	0	0	.	0	0	0	0	0	0	0	0	

128
64
32
16
8
4
2
+1
255

128
+64
192

64
-2
62

1,024
-2
1,022

Custom Subnet Masks

Problem 16

Number of needed usable hosts **29**

Network Address **23.0.0.0**

Address class A

Default subnet mask 255 . 0 . 0 . 0

Custom subnet mask 255 . 255 . 255 . 224

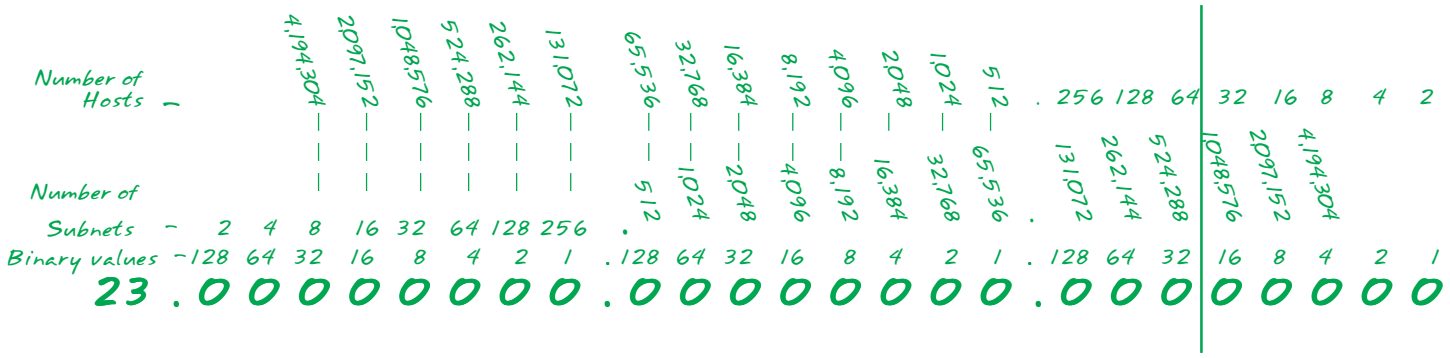
Total number of subnets 524,288

Total number of host addresses 32

Number of usable addresses 30

Number of bits borrowed 19

Show your work for Problem 16 in the space below.



128
64
+32
224

32
-2
30

524,288
-2
524,286

Subnetting

Problem 1

Number of needed subnets **14**
Number of needed usable hosts **14**
Network Address **192.10.10.0**

Address class C

Default subnet mask 255 . 255 . 255 . 0

Custom subnet mask 255 . 255 . 255 . 240

Total number of subnets 16

Total number of host addresses 16

Number of usable addresses 14

Number of bits borrowed 4

What is the 4th subnet range? 192.10.10.48 to 192.10.10.63

What is the subnet number for the 8th subnet? 192 . 10 . 10 . 112

What is the subnet broadcast address for the 13th subnet? 192 . 10 . 10 . 207

What are the assignable addresses for the 9th subnet? 192.10.10.129 to 192.10.10.142

Show your work for <u>Problem 1</u> in the space below.

Number of Subnets		256	128	64	32	16	8	4	2	–	Number of Hosts
	–	2	4	8	16	32	64	128	256		
		128	64	32	16	8	4	2	1	–	Binary values
192.10.10.0		0	0	0	0	0	0	0	0		
(1)		0	0	0	0	192.10.10.0		to			192.10.10.15
(2)		0	0	0	1	192.10.10.16		to			192.10.10.31
(3)		0	0	1	0	192.10.10.32		to			192.10.10.47
(4)		0	0	1	1	192.10.10.48		to			192.10.10.63
(5)		0	1	0	0	192.10.10.64		to			192.10.10.79
(6)		0	1	0	1	192.10.10.80		to			192.10.10.95
(7)		0	1	1	0	192.10.10.96		to			192.10.10.111
(8)		0	1	1	1	192.10.10.112		to			192.10.10.127
(9)		1	0	0	0	192.10.10.128		to			192.10.10.143
(10)		1	0	0	1	192.10.10.144		to			192.10.10.159
(11)		1	0	1	0	192.10.10.160		to			192.10.10.175
(12)		1	0	1	1	192.10.10.176		to			192.10.10.191
(13)		1	1	0	0	192.10.10.192		to			192.10.10.207
(14)		1	1	0	1	192.10.10.208		to			192.10.10.223
(15)		1	1	1	0	192.10.10.224		to			192.10.10.239
(16)		1	1	1	1	192.10.10.240		to			192.10.10.255

Custom subnet mask

128
64
32
+16
240

Usable subnets

16
−2
14

Usable hosts

16
−2
14

The binary value of the last bit borrowed is the range. In this problem the range is 16.

The first address in each subnet range is the subnet number.

The last address in each subnet range is the subnet broadcast address.

Subnetting

Problem 2

Number of needed subnets **1000**
Number of needed usable hosts **60**
Network Address **165.100.0.0**

Address class B

Default subnet mask 255 . 255 . 0 . 0

Custom subnet mask 255 . 255 . 255 . 192

Total number of subnets 1,024

Total number of host addresses 64

Number of usable addresses 62

Number of bits borrowed 10

What is the 15th subnet range? 165.100.3.128 to 165.100.3.191

What is the subnet number for the 6th subnet? 165 . 100 . 1 . 64

What is the subnet broadcast address for the 6th subnet? 165 . 100 . 1 . 127

What are the assignable addresses for the 9th subnet? 165.100.2.1 to 165.100.0.62

Show your work for Problem 2 in the space below.

Number of Hosts –	65,536	32,768	16,384	8,192	4,096	2,048	1,024	512	.	256	128	64	32	16	8	4	2
Number of Subnets –	2	4	8	16	32	64	128	256	.	512	1024	2048	4,096	8,192	16,384	32,768	65,536
Binary values –	128	64	32	16	8	4	2	1	.	128	64	32	16	8	4	2	1
165 . 100 .	0	0	0	0	0	0	0	0	.	0	0	0	0	0	0	0	0

(1)											0	165.100.0.0				to	165.100.0.63
(2)											1	165.100.0.64				to	165.100.0.127
(3)										1	0	165.100.0.128				to	165.100.0.191
(4)										1	1	165.100.0.192				to	165.100.0.255
(5)								1	.	0	0	165.100.1.0				to	165.100.1.63
(6)								1	.	0	1	165.100.1.64				to	165.100.1.127
(7)								1	.	1	0	165.100.1.128				to	165.100.1.191
(8)								1	.	1	1	165.100.1.192				to	165.100.1.255
(9)							1	0	.	0	0	165.100.2.0				to	165.100.2.63
(10)							1	0	.	0	1	165.100.2.64				to	165.100.2.127
(11)							1	0	.	1	0	165.100.2.128				to	165.100.2.191
(12)							1	0	.	1	1	165.100.2.192				to	165.100.2.255
(13)							1	1	.	0	0	165.100.3.0				to	165.100.3.63
(14)							1	1	.	0	1	165.100.3.64				to	165.100.3.127
(15)							1	1	.	1	0	165.100.3.128				to	165.100.3.191
(16)							1	1	.	1	1	165.100.3.192				to	165.100.3.255

Usable hosts

64
−2
62

128
64
32
16
8
4
2
+1
255

Custom subnet mask

128
+64
192

The binary value of the last bit borrowed is the range. In this problem the range is 64.

The first address in each subnet range is the subnet number.

The last address in each subnet range is the subnet broadcast address.

Down to

(1023)	1	1	1	1	1	1	1	1	.	1	0	165.100.255.128				to	165.100.255.191
(1024)	1	1	1	1	1	1	1	1	.	1	1	165.100.255.192				to	165.100.255.255

Subnetting

Problem 3

Hint: It is possible to borrow one bit to create two subnets.

Number of needed subnets **2**

Network Address **195.223.50.0**

Address class C

Default subnet mask 255 . 255 . 255 . 0

Custom subnet mask 255 . 255 . 255 . 128

Total number of subnets 2

Total number of host addresses 128

Number of usable addresses 126

Number of bits borrowed 1

What is the 2nd subnet range? 195.223.50.128 - 195.223.50.255

What is the subnet number for the 2nd subnet? 195.223.50.128

What is the subnet broadcast address for the 1st subnet? 195.223.50.127

What are the assignable addresses for the 1st subnet? 195.223.50.1 - 195.223.50.126

Show your work for <u>Problem 3</u> in the space below.

Number of Subnets		256	128	64	32	16	8	4	2	– Number of Hosts
		2	4	8	16	32	64	128	256	
		128	64	32	16	8	4	2	1	– Binary values
195.223.50.0		0	0	0	0	0	0	0	0	
	(1)	0	195.223.50.0 to 195.223.50.127							
	(2)	1	195.223.50.128 to 195.223.50.255							

Subnetting

Problem 4

Number of needed subnets **750**

Network Address **190.35.0.0**

Address class B

Default subnet mask 255 . 255 . 0 . 0

Custom subnet mask 255 . 255 . 255 . 192

Total number of subnets 1,024

Total number of host addresses 64

Number of usable addresses 62

Number of bits borrowed 10

What is the 15th subnet range? 190.35.3.128 to 190.35.3.191

What is the subnet number for the 13th subnet? 190.35.3.0

What is the subnet broadcast address for the 10th subnet? 190.35.2.127

What are the assignable addresses for the 6th subnet? 190.35.1.65 to 190.35.1.126

Show your work for Problem 4 in the space below.

Number of Hosts –	65,536	32,768	16,384	8,192	4,096	2,048	1,024	512	.	256	128	64	32	16	8	4	2
Number of Subnets –	2	4	8	16	32	64	128	256	.	512	1024	2048	4,096	8,192	16,384	32,768	65,536
Binary values –	128	64	32	16	8	4	2	1	.	128	64	32	16	8	4	2	1
190 . 35 .	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**.**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

									(1)			.		0	190.35.0.0	to	190.35.0.63
									(2)					1	190.35.0.64	to	190.35.0.127
									(3)				1	0	190.35.0.128	to	190.35.0.191
									(4)				1	1	190.35.0.192	to	190.35.0.255
									(5)			1	. 0	0	190.35.1.0	to	190.35.1.63
									(6)			1	. 0	1	190.35.1.64	to	190.35.1.127
									(7)			1	. 1	0	190.35.1.128	to	190.35.1.191
									(8)			1	. 1	1	190.35.1.192	to	190.35.1.255
									(9)	1		0	. 0	0	190.35.2.0	to	190.35.2.63
									(10)	1		0	. 0	1	190.35.2.64	to	190.35.2.127
									(11)	1		0	. 1	0	190.35.2.128	to	190.35.2.191
									(12)	1		0	. 1	1	190.35.2.192	to	190.35.2.255
									(13)	1		1	. 0	0	190.35.3.0	to	190.35.3.63
									(14)	1		1	. 0	1	190.35.3.64	to	190.35.3.127
									(15)	1		1	. 1	0	190.35.3.128	to	190.35.3.191
									(16)	1		1	. 1	1	190.35.3.192	to	190.35.3.255

128
64
32
16
8
4
2
+1
252

64
−2
62

128
+64
252

Subnetting

Problem 5

Number of needed usable hosts **6**

Network Address **126.0.0.0**

Address class A

Default subnet mask 255 . 0 . 0 . 0

Custom subnet mask 255 . 255 . 255 . 248

Total number of subnets 2,097,152

Total number of host addresses 8

Number of usable addresses 6

Number of bits borrowed 21

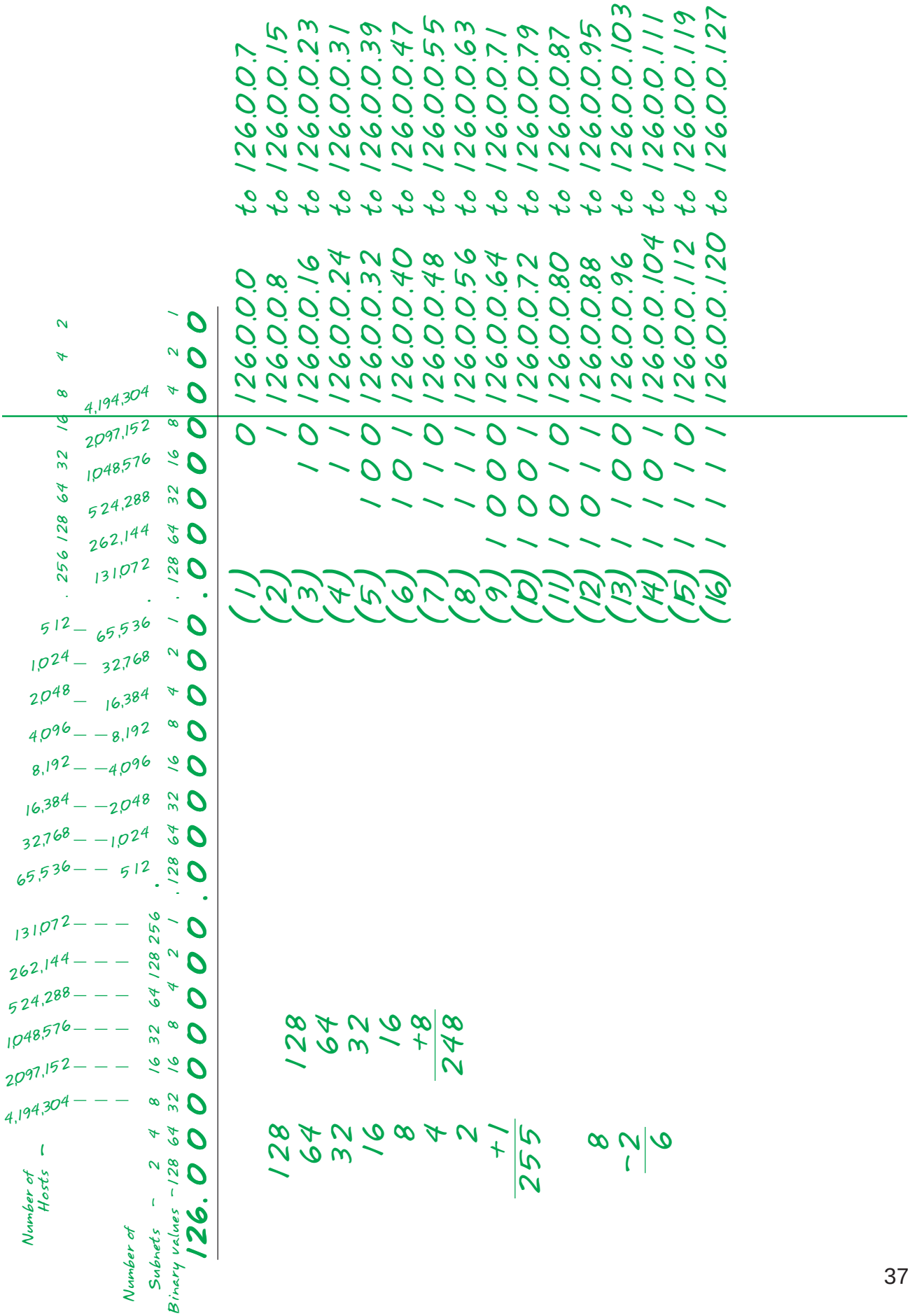
What is the 2nd subnet range? 126.0.0.8 to 126.0.0.15

What is the subnet number for the 5th subnet? 126.0.0.32

What is the subnet broadcast address for the 7th subnet? 126.0.0.55

What are the assignable addresses for the 10th subnet? 126.0.0.73 to 126.0.0.78

Show your work for <u>Problem 5</u> in the space below.



Subnetting

Problem 6

Number of needed subnets **10**

Network Address **192.70.10.0**

Address class C

Default subnet mask 255 . 255 . 255 . 0

Custom subnet mask 255 . 255 . 255 . 240

Total number of subnets 16

Total number of host addresses 16

Number of usable addresses 14

Number of bits borrowed 4

What is the 9th subnet range? 192.70.10.128 to 192.70.10.143

What is the subnet number for the 4th subnet? 192.70.10.48

What is the subnet broadcast address for the 12th subnet? 192.70.10.191

What are the assignable addresses for the 10th subnet? 192.70.10.145 to 192.70.10.158

Show your work for <u>Problem 6</u> in the space below.

Number of Subnets		256	128	64	32	16	8	4	2	Number of Hosts
		2	4	8	16	32	64	128	256	
		128	64	32	16	8	4	2	1	Binary values
192 . 70 . 10 .		0	0	0	0	0	0	0	0	
	(1)				0	192.70.10.0	to	192.70.10.15		
	(2)				1	192.70.10.16	to	192.70.10.31		
	(3)			1	0	192.70.10.32	to	192.70.10.47		
	(4)			1	1	192.70.10.48	to	192.70.10.63		
	(5)		1	0	0	192.70.10.64	to	192.70.10.79		
	(6)		1	0	1	192.70.10.80	to	192.70.10.95		
	(7)		1	1	0	192.70.10.96	to	192.70.10.111		
	(8)		1	1	1	192.70.10.112	to	192.70.10.127		
	(9)	1	0	0	0	192.70.10.128	to	192.70.10.143		
	(10)	1	0	0	1	192.70.10.144	to	192.70.10.159		
	(11)	1	0	1	0	192.70.10.160	to	192.70.10.175		
	(12)	1	0	1	1	192.70.10.176	to	192.70.10.191		
	(13)	1	1	0	0	192.70.10.192	to	192.70.10.0207		
	(14)	1	1	0	1	192.70.10.208	to	192.70.10.223		
	(15)	1	1	1	0	192.70.10.224	to	192.70.10.239		
	(16)	1	1	1	1	192.70.10.240	to	192.70.10.255		

128	16
+64	-2
240	14

Subnetting

Problem 7

Network Address **10.0.0.0 /16**

Address class A

Default subnet mask 255 . 0 . 0 . 0

Custom subnet mask 255 . 255 . 0 . 0

Total number of subnets 256

Total number of host addresses 65,536

Number of usable addresses 65,534

Number of bits borrowed 8

What is the 11th subnet range? 10.10.0.0 to 10.10.255.255

What is the subnet number for the 6th subnet? 10.5.0.0

What is the subnet broadcast address for the 2nd subnet? 10.1.255.255

What are the assignable addresses for the 9th subnet? 10.8.0.1 to 10.8.255.254

Show your work for <u>Problem 7</u> in the space below.

Subnetting

Problem 8

Number of needed subnets **5**

Network Address **172.50.0.0**

Address class B

Default subnet mask 255 . 255 . 0 . 0

Custom subnet mask 255 . 255 . 224 . 0

Total number of subnets 8

Total number of host addresses 8,192

Number of usable addresses 8,190

Number of bits borrowed 3

What is the 4th subnet range? 172.50.96.0 to 172.50.127.255

What is the subnet number for the 5th subnet? 172.50.128.0

What is the subnet broadcast address for the 6th subnet? 172.50.191.255

What are the assignable addresses for the 3rd subnet? 172.50.64.1 to 172.50.95.254

Show your work for Problem 8 in the space below.

Number of Hosts –	65,536	32,768	16,384	8,192	4,096	2,048	1,024	512	.	256	128	64	32	16	8	4	2
Number of Subnets –	2	4	8	16	32	64	128	256	.	512	1024	2048	4,096	8,192	16,384	32,768	65,536
Binary values –	128	64	32	16	8	4	2	1	.	128	64	32	16	8	4	2	1
172 . 50 .	0	0	0	0	0	0	0	0	.	0	0	0	0	0	0	0	0

(1)			0	172.50.0.0	to	172.50.31.255
(2)			1	172.50.32.0	to	172.50.63.255
(3)		1	0	172.50.64.0	to	172.50.95.255
(4)		1	1	172.50.96.0	to	172.50.127.255
(5)	1	0	0	172.50.128.0	to	172.50.159.255
(6)	1	0	1	172.50.160.0	to	172.50.191.255
(7)	1	1	0	172.50.192.0	to	172.50.223.255
(8)	1	1	1	172.50.224.0	to	172.50.255.255

$$\begin{array}{r} 128 \\ 64 \\ +32 \\ \hline 224 \end{array}$$

$$\begin{array}{r} 8{,}192 \\ -2 \\ \hline 8{,}190 \end{array}$$

Subnetting

Problem 9

Number of needed usable hosts **28**

Network Address **172.50.0.0**

Address class B

Default subnet mask 255 . 255 . 0 . 0

Custom subnet mask 255 . 255 . 255 . 224

Total number of subnets 2,048

Total number of host addresses 32

Number of usable addresses 30

Number of bits borrowed 11

What is the 2nd subnet range? 172.50.0.32 to 172.50.0.63

What is the subnet number for the 10th subnet? 172.50.1.32

What is the subnet broadcast address for the 4th subnet? 172.50.0.127

What are the assignable addresses for the 6th subnet? 172.50.0.161 to 172.50.0.190

Show your work for Problem 9 in the space below.

Number of Hosts –	65,536	32,768	16,384	8,192	4,096	2,048	1,024	512	.	256	128	64	32	16	8	4	2
Number of Subnets –	2	4	8	16	32	64	128	256	.	512	1024	2048	4,096	8,192	16,384	32,768	65,536
Binary values –	128	64	32	16	8	4	2	1	.	128	64	32	16	8	4	2	1
172 . 50 .	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**.**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

(1)		.			0	172.50.0.0	to	172.50.0.31
(2)					1	172.50.0.32	to	172.50.0.63
(3)				1	0	172.50.0.64	to	172.50.0.95
(4)				1	1	172.50.0.96	to	172.50.0.127
(5)			1	0	0	172.50.0.128	to	172.50.0.159
(6)			1	0	1	172.50.0.160	to	172.50.0.191
(7)			1	1	0	172.50.0.192	to	172.50.0.223
(8)			1	1	1	172.50.0.224	to	172.50.0.255
(9)	1	.	0	0	0	172.50.1.0	to	172.50.1.31
(10)	1	.	0	0	1	172.50.1.32	to	172.50.1.63
(11)	1	.	0	1	0	172.50.1.64	to	172.50.1.95
(12)	1	.	0	1	1	172.50.1.96	to	172.50.1.127
(13)	1		1	0	0	172.50.1.128	to	172.50.1.159
(14)	1	.	1	0	1	172.50.1.160	to	172.50.1.191
(15)	1	.	1	1	0	172.50.1.192	to	172.50.1.223
(16)	1	.	1	1	1	172.50.1.224	to	172.50.1.255

128
64
32
16
8
4
2
+1
252

128
64
+32
224

32
−2
30

Subnetting

Problem 10

Number of needed subnets **45**

Network Address **220.100.100.0**

Address class C

Default subnet mask 255 . 255 . 255 . 0

Custom subnet mask 255 . 255 . 255 . 252

Total number of subnets 64

Total number of host addresses 4

Number of usable addresses 2

Number of bits borrowed 6

What is the 5th subnet range? 220.100.100.16 to 220.100.100.19

What is the subnet number for the 4th subnet? 220.100.100.12

What is the subnet broadcast address for the 13th subnet? 220.100.100.51

What are the assignable addresses for the 12th subnet? 220.100.100.45 to 220.100.100.46

Show your work for Problem 10 in the space below.

		256	128	64	32	16	8	4	2	– Number of Hosts
	Number of Subnets –	2	4	8	16	32	64	128	256	
		128	64	32	16	8	4	2	1	– Binary values
220 . 100 . 100 .		0	0	0	0	0	0	0	0	
	(1)						0	220.100.100.0	to	220.100.100.3
	(2)						1	220.100.100.4	to	220.100.100.7
	(3)					1	0	220.100.100.8	to	220.100.100.11
	(4)					1	1	220.100.100.12	to	220.100.100.15
	(5)				1	0	0	220.100.100.16	to	220.100.100.19
	(6)				1	0	1	220.100.100.20	to	220.100.100.23
	(7)				1	1	0	220.100.100.24	to	220.100.100.27
	(8)				1	1	1	220.100.100.28	to	220.100.100.31
	(9)			1	0	0	0	220.100.100.32	to	220.100.100.35
	(10)			1	0	0	1	220.100.100.36	to	220.100.100.39
	(11)			1	0	1	0	220.100.100.40	to	220.100.100.43
	(12)			1	0	1	1	220.100.100.44	to	220.100.100.47
	(13)			1	1	0	0	220.100.100.48	to	220.100.100.51
	(14)			1	1	0	1	220.100.100.52	to	220.100.100.55
	(15)			1	1	1	0	220.100.100.56	to	220.100.100.59
	(16)			1	1	1	1	220.100.100.60	to	220.100.100.63

128
64
32
16
8
+4
252

4
−2
2

Subnetting

Problem 11

Number of needed usable hosts **8,000**

Network Address **135.70.0.0**

Address class B

Default subnet mask 255 . 255 . 0 . 0

Custom subnet mask 255 . 255 . 224 . 0

Total number of subnets 8

Total number of host addresses 8,192

Number of usable addresses 8,190

Number of bits borrowed 3

What is the 6th subnet range? 135.70.160.0 to 135.70.191.255

What is the subnet number for the 7th subnet? 135.70.192.0

What is the subnet broadcast address for the 3rd subnet? 135.70.95.255

What are the assignable addresses for the 5th subnet? 135.70.128.1 to 135.70.159.254

Show your work for <u>Problem 11</u> in the space below.

Number of Hosts - 65,536 32,768 16,384 8,192 4,096 2,048 1,024 512

Number of Subnets - 2 4 8 16 32 64 128 256

Binary values - 128 64 32 16 8 4 2 1

135 . 70 . 0 0 0 0 0 0 0 0

(1)	0	135.70.0.0 to	135.70.31.255
(2)	1	135.70.32.0 to	135.70.63.255
(3)	1 0	135.70.64.0 to	135.70.95.255
(4)	1 1	135.70.96.0 to	135.70.127.255
(5)	1 0 0	135.70.128.0 to	135.70.159.255
(6)	1 0 1	135.70.160.0 to	135.70.191.255
(7)	1 1 0	135.70.192.0 to	135.70.223.255
(8)	1 1 1	135.70.224.0 to	135.70.255.255

128
64
+32
224

8,192
-2
8,190

Subnetting

Problem 12

Number of needed usable hosts **45**

Network Address **198.125.50.0**

Address class C

Default subnet mask 255 . 255 . 255 . 0

Custom subnet mask 255 . 255 . 255 . 192

Total number of subnets 4

Total number of host addresses 64

Number of usable addresses 62

Number of bits borrowed 2

What is the 2nd subnet range? 198.125.50.64 to 98.125.50.127

What is the subnet number for the 2nd subnet? 198.125.50.64

What is the subnet broadcast address for the 4th subnet? 198.125.50.255

What are the assignable addresses for the 3rd subnet? 198.125.50.129 to 198.125.50.190

Show your work for <u>Problem 12</u> in the space below.

Number of Subnets			256	128	64	32	16	8	4	2	- Number of Hosts
			- 2	4	8	16	32	64	128	256	
			128	64	32	16	8	4	2	1	- Binary values
198 . 125 . 50 .			0	0	0	0	0	0	0	0	
(1)		0	198.125.50.0	to	198.125.50.63						
(2)		1	198.125.50.64	to	198.125.50.127						
(3)	1	0	198.125.50.128	to	198.125.50.191						
(4)	1	1	198.125.50.192	to	198.125.50.255						

128	64
+64	-2
192	62

Subnetting

Problem 13

Network Address **165.200.0.0 /26**

Address class B

Default subnet mask 255 . 255 . 0 . 0

Custom subnet mask 255 . 255 . 255 . 192

Total number of subnets 1,024

Total number of host addresses 64

Number of usable addresses 62

Number of bits borrowed 10

What is the 10th subnet range? 165.200.2.64 to 165.200.2.127

What is the subnet number for the 11th subnet? 165.200.2.128

What is the subnet broadcast address for the 1023rd subnet? 165.200.255.191

What are the assignable addresses for the 1022nd subnet? 165.200.255.65 to 165.200.255.126

Show your work for <u>Problem 13</u> in the space below.

Number of Hosts - 65,536 32,768 16,384 8,192 4,096 2048 1024 512

Number of Subnets - 2 4 8 16 32 64 128 256

Binary values - 128 64 32 16 8 4 2 1 . 128 64 32 16 8 4 2 1

165 . 200 . 0 0 0 0 . 0 0 0 0 0 0 0 0

Subnetting

Problem 14

Number of needed usable hosts **16**

Network Address **200.10.10.0**

Address class C

Default subnet mask 255 . 255 . 255 . 0

Custom subnet mask 255 . 255 . 255 . 224

Total number of subnets 8

Total number of host addresses 32

Number of usable addresses 30

Number of bits borrowed 3

What is the 7th subnet range? 200.10.10.192 to 200.10.10.223

What is the subnet number for the 5th subnet? 200.10.10.128

What is the subnet broadcast address for the 4th subnet? 200.10.10.127

What are the assignable addresses for the 6th subnet? 200.10.10.161 to 200.10.10.190

Show your work for <u>Problem 14</u> in the space below.

Number of Subnets		256	128	64	32	16	8	4	2	Number of Hosts
		2	4	8	16	32	64	128	256	
		128	64	32	16	8	4	2	1	Binary values
200 . 10 . 10 .		0	0	0	0	0	0	0	0	
	(1)			0	200.10.10.0		to		200.10.10.31	
	(2)			1	200.10.10.32		to		200.10.10.63	
	(3)		1	0	200.10.10.64		to		200.10.10.95	
	(4)		1	1	200.10.10.96		to		200.10.10.127	
	(5)	1	0	0	200.10.10.128		to		200.10.10.159	
	(6)	1	0	1	200.10.10.160		to		200.10.10.191	
	(7)	1	1	0	200.10.10.192		to		200.10.10.223	
	(8)	1	1	1	200.10.10.224		to		200.10.10.255	

128
64
+32
224

32
-2
30

Subnetting

Problem 15

Network Address **93.0.0.0 \19**

Address class A

Default subnet mask 255 . 0 . 0 . 0

Custom subnet mask 255 . 255 . 224 . 0

Total number of subnets 2,048

Total number of host addresses 8,192

Number of usable addresses 8,190

Number of bits borrowed 11

What is the 15th subnet range? 93.1.192.0 to 93.1.223.255

What is the subnet number for the 9th subnet? 93.1.0.0

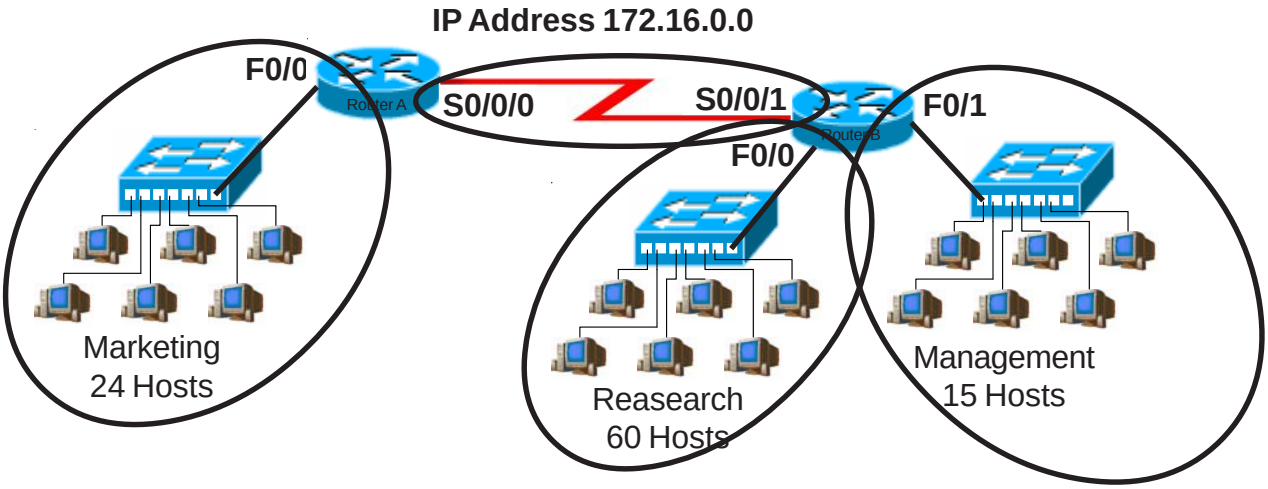
What is the subnet broadcast address for the 7th subnet? 93.0.223.255

What are the assignable addresses for the 12th subnet? 93.1.96.1 to 93.1.127.254

Show your work for <u>Problem 15</u> in the space below.

Practical Subnetting 1

Based on the information in the graphic shown, design a network addressing scheme that will supply the **minimum number of subnets**, and allow enough extra subnets and hosts for 100% growth in both areas. Circle each subnet on the graphic and answer the questions below.



Address class	B
Custom subnet mask	255.255.224.0
Minimum number of subnets needed	4
Extra subnets required for 100% growth (Round up to the next whole number)	+ 4
Total number of subnets needed	= 8
Number of host addresses in the largest subnet group	60
Number of addresses needed for 100% growth in the largest subnet (Round up to the next whole number)	+ 60
Total number of address needed for the largest subnet	= 120

Start with the first subnet and arrange your sub-networks from the largest group to the smallest.

IP address range for Research	172.16.0.0 to 172.31.255
IP address range for Marketing	172.16.32.0 to 172.63.255
IP address range for Management	172.16.64.0 to 172.95.255
IP address range for Router A to Router B serial connection	172.16.96.0 to 172.127.255

Show your work for Practical Subnetting 1 in the space below.

Number of Hosts - 65,536 32,768 16,384 8,192 4,096 2,048 1,024 512

Number of Subnets - 2 4 8 16 32 64 128 256.

Binary values - 128 64 32 16 8 4 2 1 . 128 64 32 16 8 4 2 1

172 . 16 . 0 0 0 0 0 . 0 0 0 0 0 0 0 0

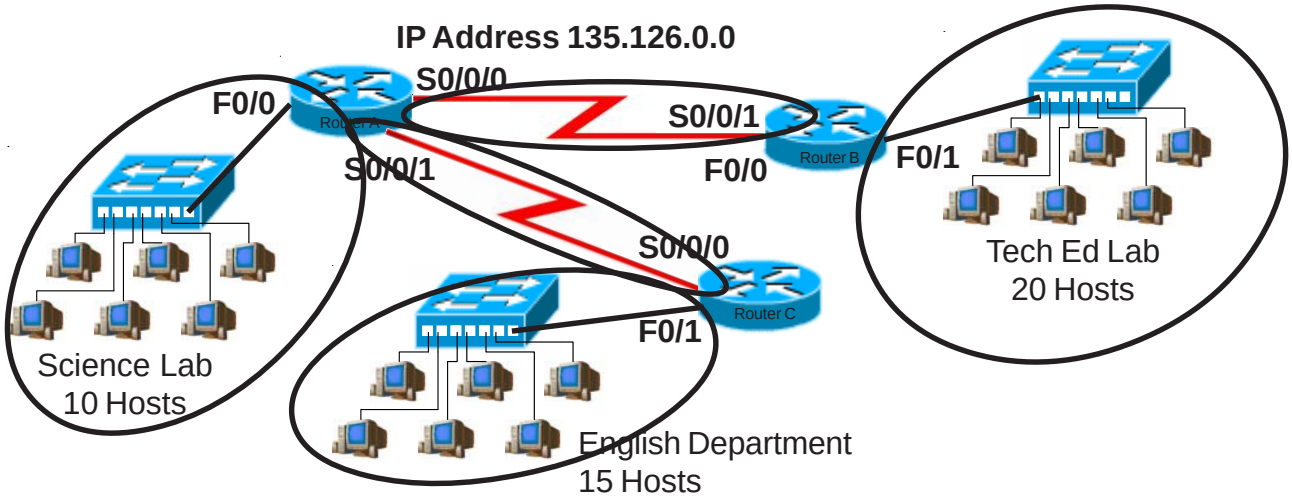
(1)	0	172.16.0.0	to 172.16.31.255
(2)	1	172.16.32.0	to 172.16.63.255
(3)	1 0	172.16.64.0	to 172.16.95.255
(4)	1 1	172.16.96.0	to 172.16.127.255
(5)	1 0 0	172.16.128.0	to 172.16.159.255
(6)	1 0 1	172.16.160.0	to 172.16.191.255
(7)	1 1 0	172.16.192.0	to 172.16.223.255
(8)	1 1 1	172.16.224.0	to 172.16.255.255

4
×10
4

60
×10
60

Practical Subnetting 2

Based on the information in the graphic shown, design a network addressing scheme that will supply the **minimum number of hosts per subnet**, and allow enough extra subnets and hosts for 30% growth in all areas. Circle each subnet on the graphic and answer the questions below.



Address class	B
Custom subnet mask	255.255.255.224
Minimum number of subnets needed	5
Extra subnets required for 30% growth (Round up to the next whole number)	+ 2
Total number of subnets needed	= 7
Number of host addresses in the largest subnet group	20
Number of addresses needed for 30% growth in the largest subnet (Round up to the next whole number)	+ 6
Total number of address needed for the largest subnet	= 26

Start with the first subnet and arrange your sub-networks from the largest group to the smallest.

IP address range for Tech Ed	135.126.0.0 to 135.126.0.31
IP address range for English	135.126.0.32 to 135.126.0.63
IP address range for Science	135.126.0.64 to 135.126.0.95
IP address range for Router A to Router B serial connection	135.126.0.96 to 135.126.0.127
IP address range for Router A to Router B serial connection	135.126.0.128 to 135.126.0.159

Show your work for Problem 2 in the space below.

Number of Hosts –	65,536	32,768	16,384	8,192	4,096	2,048	1,024	512	.	256	128	64	32	16	8	4	2
Number of Subnets –	2	4	8	16	32	64	128	256	.	512	1024	2048	4,096	8,192	16,384	32,768	65,536
Binary values –	128	64	32	16	8	4	2	1	.	128	64	32	16	8	4	2	1
135.126.	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	.	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

(1)		.			0	135.126.0.0	to	135.126.0.31
(2)					1	135.126.0.32	to	135.126.0.63
(3)				1	0	135.126.0.64	to	135.126.0.95
(4)				1	1	135.126.0.96	to	135.126.0.127
(5)			1	0	0	135.126.0.128	to	135.126.0.159
(6)			1	0	1	135.126.0.160	to	135.126.0.191
(7)			1	1	0	135.126.0.192	to	135.126.0.223
(8)			1	1	1	135.126.0.224	to	135.126.0.255
(9)	1	.	0	0	0	135.126.1.0	to	135.126.1.31
(10)	1	.	0	0	1	135.126.1.32	to	135.126.1.63
(11)	1	.	0	1	0	135.126.1.64	to	135.126.1.95
(12)	1	.	0	1	1	135.126.1.96	to	135.126.1.127
(13)	1		1	0	0	135.126.1.128	to	135.126.1.159
(14)	1	.	1	0	1	135.126.1.160	to	135.126.1.191
(15)	1	.	1	1	0	135.126.1.192	to	135.126.1.223
(16)	1	.	1	1	1	135.1261.224	to	135.126.1.255

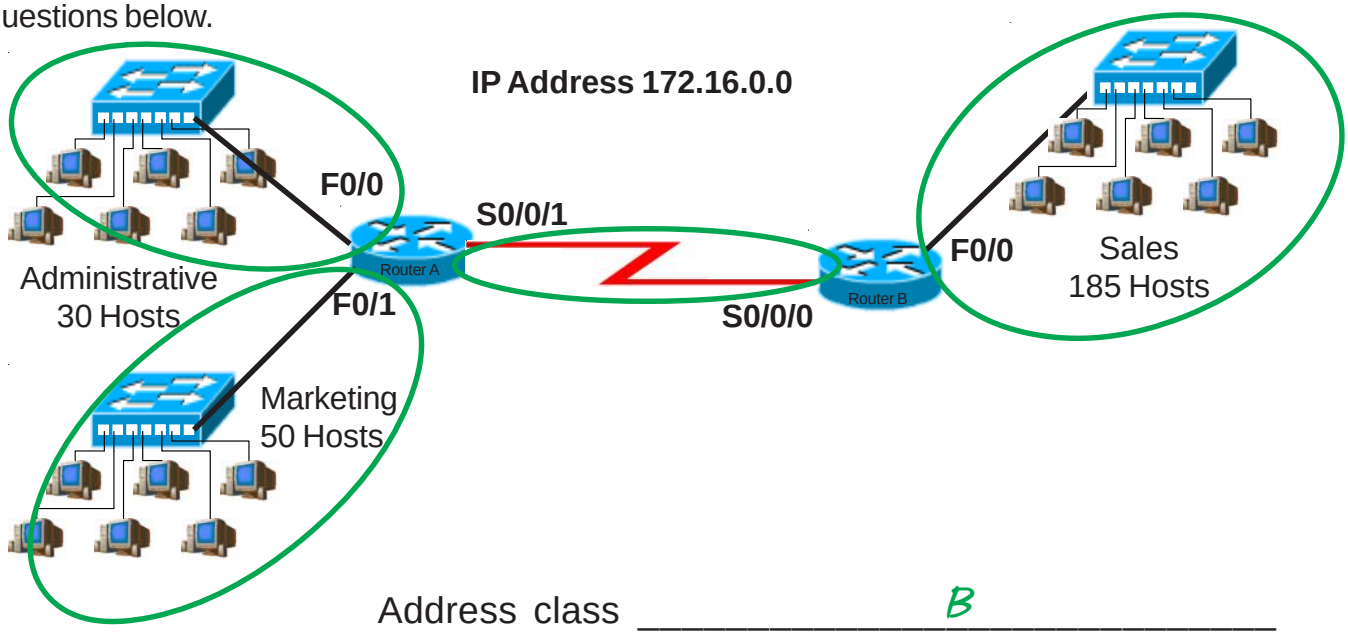
$$\begin{array}{r} 5 \\ \times .3 \\ \hline 1.5 \end{array}$$

(Round up to 2)

$$\begin{array}{r} 20 \\ \times .3 \\ \hline 6 \end{array}$$

Practical Subnetting 3

Based on the information in the graphic shown, design a classfull network addressing scheme that will supply the **minimum number of hosts per subnet**, and allow enough extra subnets and hosts for 25% growth in all areas. Circle each subnet on the graphic and answer the questions below.



Address class	B
Custom subnet mask	255.255.255.0
Minimum number of subnets needed	4
Extra subnets required for 25% growth (Round up to the next whole number)	+ 1
Total number of subnets needed	= 5
Number of host addresses in the largest subnet group	185
Number of addresses needed for 25% growth in the largest subnet (Round up to the next whole number)	+ 47
Total number of address needed for the largest subnet	= 232

Start with the first subnet and arrange your sub-networks from the largest group to the smallest.

IP address range for Sales	172.16.0.0 to 172.16.0.255
IP address range for Marketing	172.16.1.0 to 172.16.1.255
IP address range for Administrative	172.16.2.0 to 172.16.2.255
IP address range for Router A to Router B serial connection	172.16.3.0 to 172.16.3.255

Show your work for <u>Problem 3</u> in the space below.

Number of Hosts - 65,536 32,768 16,384 8,192 4,096 2048 1024 512

Number of Subnets - 2 4 8 16 32 64 128 256

Binary values - 128 64 32 16 8 4 2 1

172.16.0.0000000.0000000

512 ---- 1,024 ---- 2,048 ---- 4,096 ---- 8,192 ---- 16,384 ---- 32,768 ---- 65,536

(1)	0	0	0	0	0	0	0	0	.	172.16.0.0	to	172.16.0.255
(2)	0	0	0	0	0	0	0	1	.	172.16.1.0	to	172.16.1.255
(3)	0	0	0	0	0	0	1	0	.	172.16.2.0	to	172.16.2.255
(4)	0	0	0	0	0	0	1	1	.	172.16.3.0	to	172.16.3.255
(5)	0	0	0	0	0	1	0	0	.	172.16.4.0	to	172.16.4.255
(6)	0	0	0	0	0	1	0	1	.	172.16.5.0	to	172.16.5.255
(7)	0	0	0	0	0	1	1	0	.	172.16.6.0	to	172.16.6.255
(8)	0	0	0	0	0	1	1	1	.	172.16.7.0	to	172.16.7.255
(9)	0	0	0	0	1	0	0	0	.	172.16.8.0	to	172.16.8.255
(10)	0	0	0	0	1	0	0	1	.	172.16.9.0	to	172.16.9.255
(11)	0	0	0	0	1	0	1	0	.	172.16.10.0	to	172.16.10.255
(12)	0	0	0	0	1	0	1	1	.	172.16.11.0	to	172.16.11.255
(13)	0	0	0	0	1	1	0	0	.	172.16.12.0	to	172.16.12.255
(14)	0	0	0	0	1	1	0	1	.	172.16.13.0	to	172.16.13.255
(15)	0	0	0	0	1	1	1	0	.	172.16.14.0	to	172.16.14.255
(16)	0	0	0	0	1	1	1	1	.	172.16.15.0	to	172.16.15.255

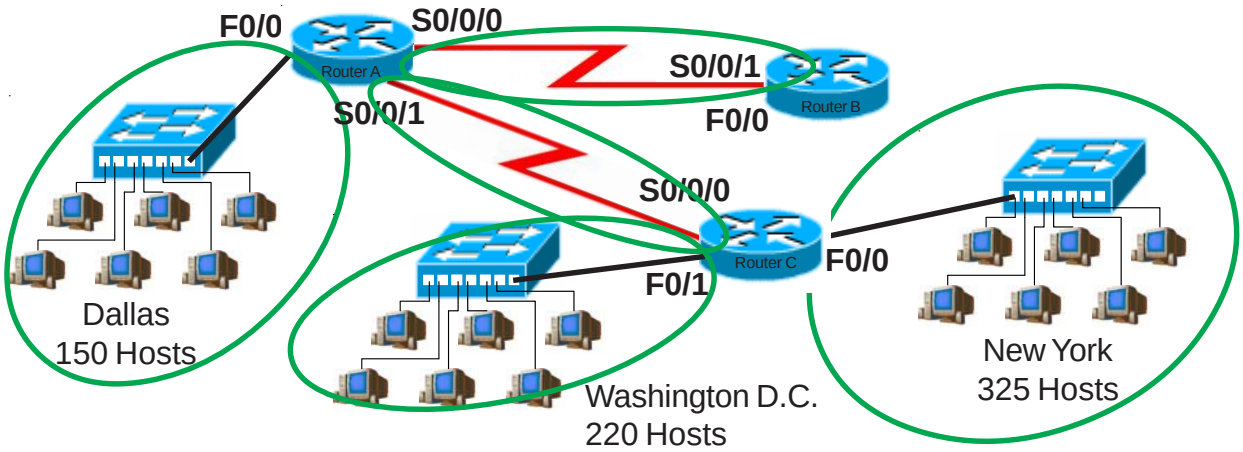
4
x .25
1

225
x .25
56.25
(Round up to 57)

Practical Subnetting 4

Based on the information in the graphic shown, design a network addressing scheme that will supply the **minimum number of subnets**, and allow enough extra subnets and hosts for 70% growth in all areas. Circle each subnet on the graphic and answer the questions below.

IP Address 135.126.0.0



Address class ___B___

Custom subnet mask ___255.255.240.0___

Minimum number of subnets needed ___5___

Extra subnets required for 70% growth + ___4___
(Round up to the next whole number)

Total number of subnets needed = ___9___

Number of host addresses in the largest subnet group ___325___

Number of addresses needed for 70% growth in the largest subnet + ___228___
(Round up to the next whole number)

Total number of address needed for the largest subnet = ___553___

Start with the first subnet and arrange your sub-networks from the largest group to the smallest.

IP address range for New York ___135.126.0.0 to 135.126.15.255___

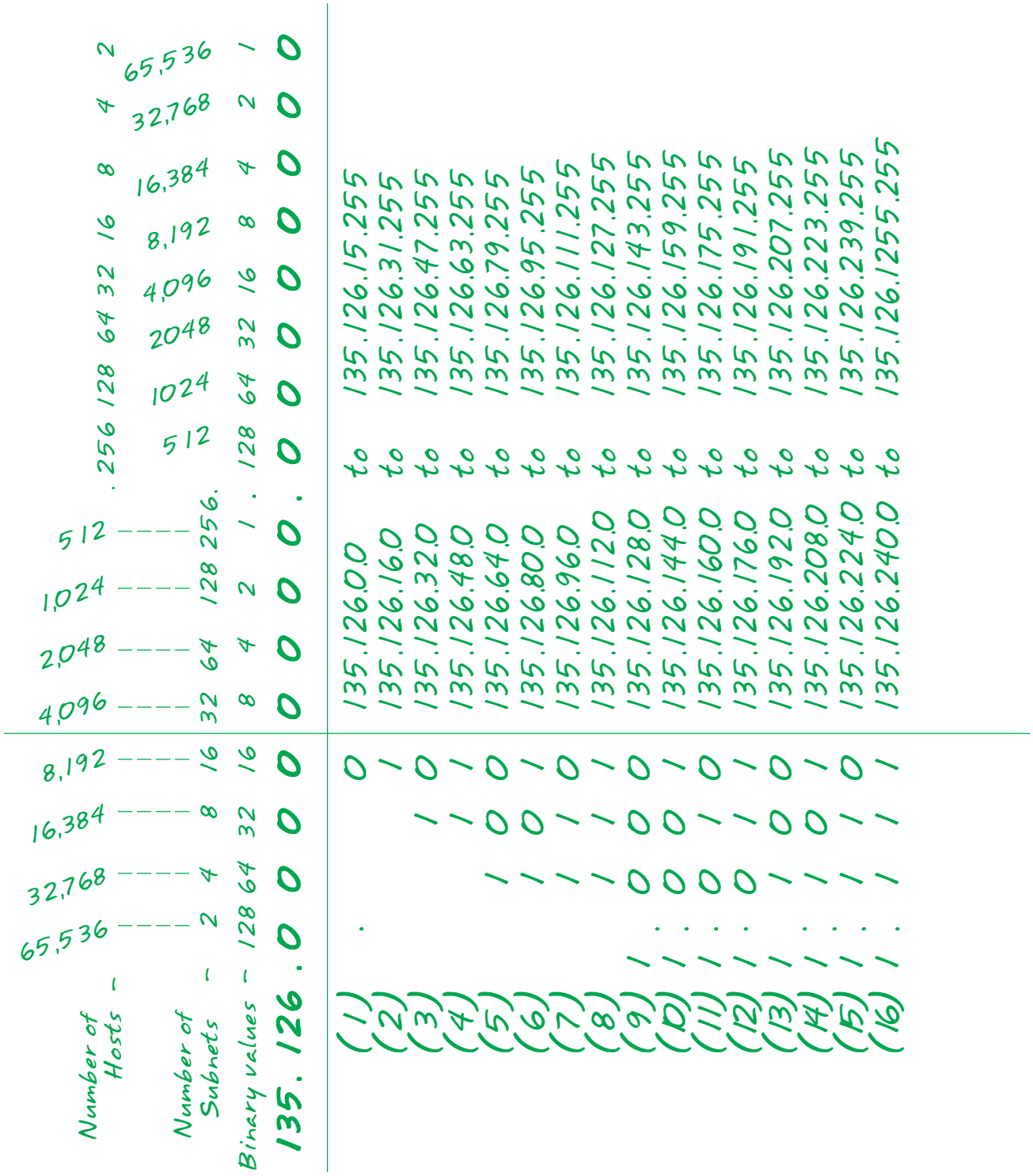
IP address range for Washington D. C. ___135.126.16.0 to 135.126.31.255___

IP address range for Dallas ___135.126.32.0 to 135.126.47.255___

IP address range for Router A to Router B serial connection ___135.126.48.0 to 135.126.63.255___

IP address range for Router A to Router C serial connection ___135.126.64.0 to 135.126.79.255___

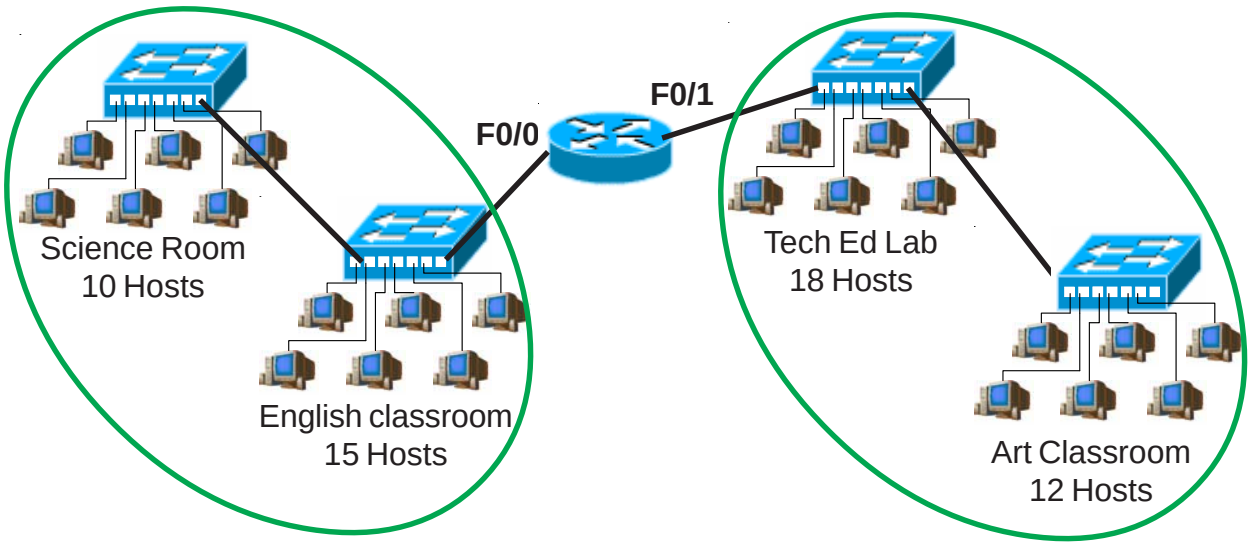
Show your work for <u>Problem 4</u> in the space below.



Practical Subnetting 5

Based on the information in the graphic shown, design a network addressing scheme that will supply the **minimum number of hosts per subnet**, and allow enough extra subnets and hosts for 100% growth in all areas. Circle each subnet on the graphic and answer the questions below.

IP Address 210.15.10.0



Address class _____ C

Custom subnet mask _____ 255.255.255.192

Minimum number of subnets needed _____ 2

Extra subnets required for 100% growth + 2
(Round up to the next whole number)

Total number of subnets needed = 4

Number of host addresses in the largest subnet group _____ 30

Number of addresses needed for 100% growth in the largest subnet + 30
(Round up to the next whole number)

Total number of address needed for the largest subnet = 60

Start with the first subnet and arrange your sub-networks from the largest group to the smallest.

IP address range for Router F0/0 Port _____ 210.15.10.0 to 210.15.10.63

IP address range for Router F0/1 Port _____ 210.15.10.64 to 210.15.10.127

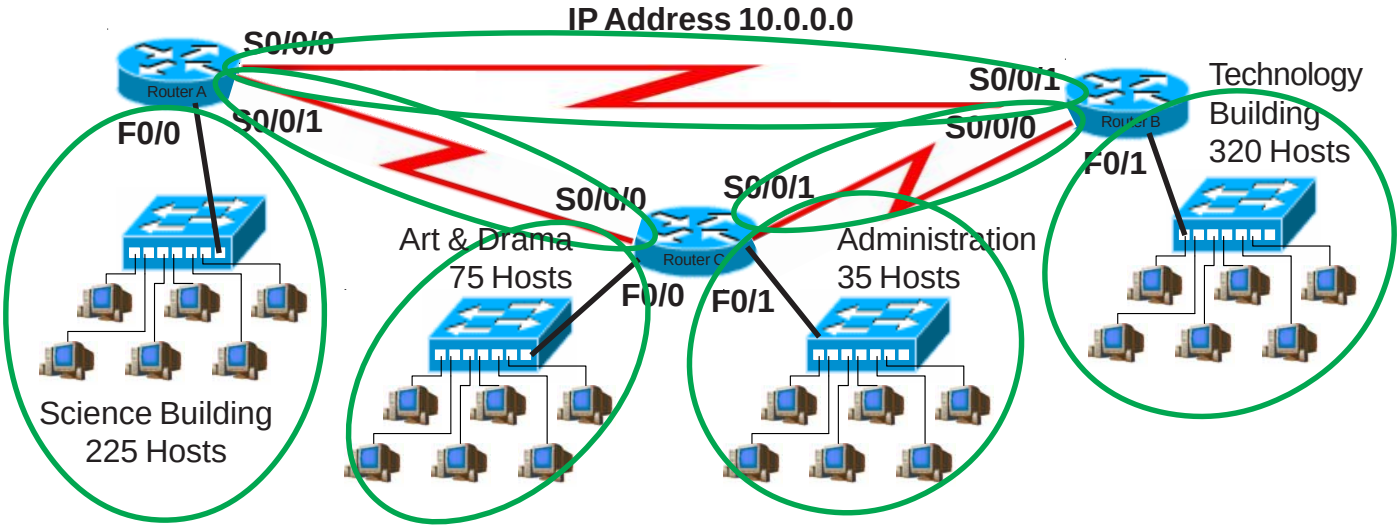
Show your work for <u>Problem 5</u> in the space below.

Number of Subnets	256	128	64	32	16	8	4	2	Number of Hosts
	2	4	8	16	32	64	128	256	
	128	64	32	16	8	4	2	1	Binary values
210.15.10.0	0	0	0	0	0	0	0	0	

(1)	0		210.15.10.0	to	210.15.10.63
(2)	1		210.15.10.64	to	210.15.10.127
(3)	1	0	210.15.10.128	to	210.15.10.191
(4)	1	1	210.15.10.192	to	210.15.10.255

Practical Subnetting 6

Based on the information in the graphic shown, design a network addressing scheme that will supply the **minimum number of subnets**, and allow enough extra subnets and hosts for 20% growth in all areas. Circle each subnet on the graphic and answer the questions below.



Address class	A
Custom subnet mask	255.240.0.0
Minimum number of subnets needed	7
Extra subnets required for 20% growth (Round up to the next whole number)	+ 2
Total number of subnets needed	= 9

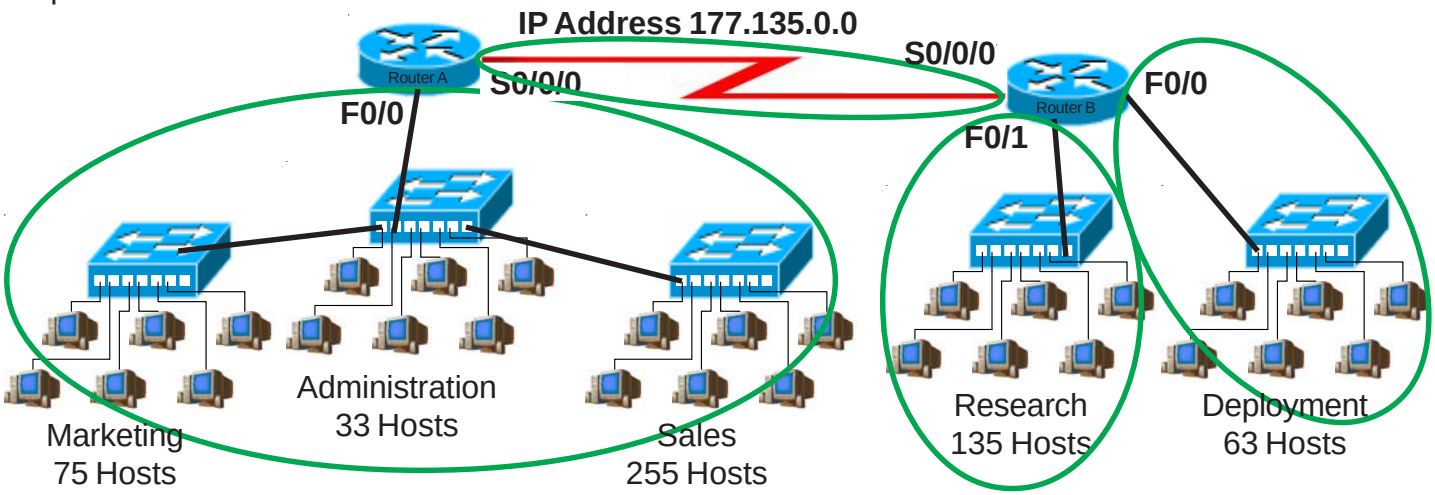
Start with the first subnet and arrange your sub-networks from the largest group to the smallest.

IP address range for Technology	10.0.0.0 to 10.15.255.255
IP address range for Science	10.16.0.0 to 10.31.255.255
IP address range for Arts & Drama	10.32.0.0 to 10.47.255.255
IP Address range Administration	10.48.0.0 to 10.63.255.255
IP address range for Router A to Router B serial connection	10.64.0.0 to 10.79.255.255
IP address range for Router A to Router C serial connection	10.80.0.0 to 10.95.255.255
IP address range for Router B to Router C serial connection	10.96.0.0 to 10.111.255.255

Show your work for <u>Problem 6</u> in the space below.

Practical Subnetting 7

Based on the information in the graphic shown, design a network addressing scheme that will supply the **minimum number of hosts per subnet**, and allow enough extra subnets and hosts for 125% growth in all areas. Circle each subnet on the graphic and answer the questions below.



Address class _____ B

Custom subnet mask _____ 255.255.252.0

Minimum number of subnets needed _____ 4

Extra subnets required for 125% growth + _____ 5
(Round up to the next whole number)

Total number of subnets needed = _____ 9

Number of host addresses in the largest subnet group _____ 363

Number of addresses needed for 125% growth in the largest subnet + _____ 454
(Round up to the next whole number)

Total number of address needed for the largest subnet = _____ 817

Start with the first subnet and arrange your sub-networks from the largest group to the smallest.

IP address range for Router A Port F0/0 _____ 177.135.0.0 to 177.135.3.255

IP address range for Research _____ 177.135.4.0 to 177.135.7.255

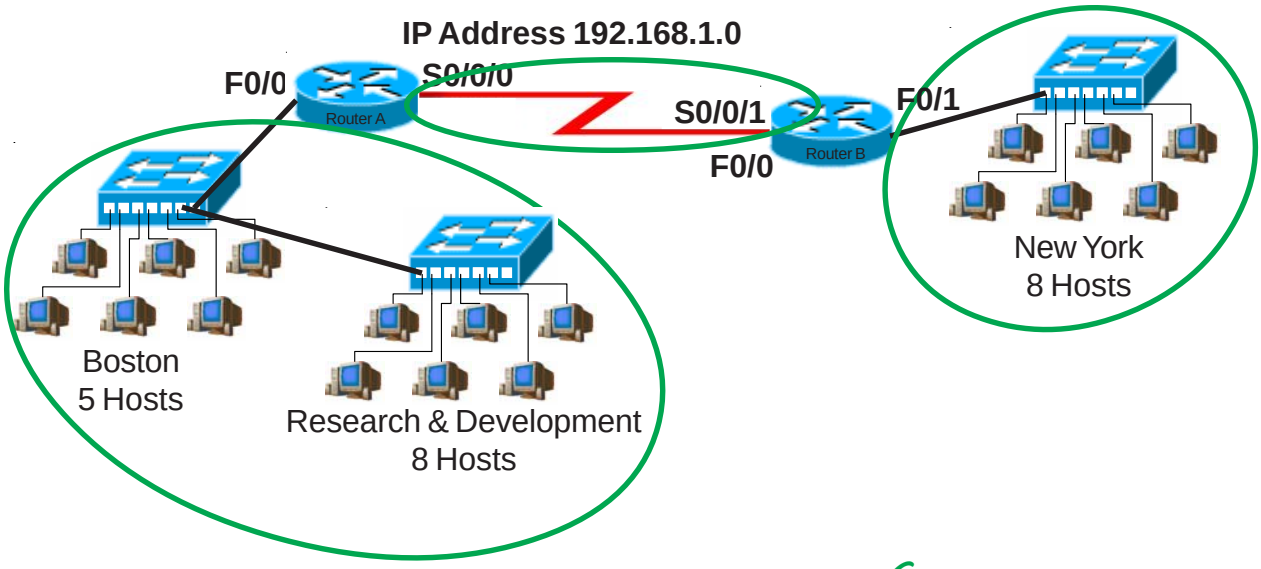
IP address range for Deployment _____ 177.135.8.0 to 177.135.11.255

IP address range for Router A to Router B serial connection _____ 177.135.12.0 to 177.135.15.255

Show your work for <u>Problem 7</u> in the space below.

Practical Subnetting 8

Based on the information in the graphic shown, design a network addressing scheme that will supply the **minimum number subnets**, and allow enough extra subnets and hosts for 85% growth in all areas. Circle each subnet on the graphic and answer the questions below.



Address class _____ C

Custom subnet mask _____ 255.255.255.224

Minimum number of subnets needed _____ 3

Extra subnets required for 85% growth + 3
(Round up to the next whole number)

Total number of subnets needed = 6

Number of host addresses in the largest subnet group _____ 13

Number of addresses needed for 85% growth in the largest subnet + 12
(Round up to the next whole number)

Total number of address needed for the largest subnet = 25

Start with the first subnet and arrange your sub-networks from the largest group to the smallest.

IP address range for Router A F0/0 _____ 192.168.1.0 to 192.168.1.31

IP address range for New York _____ 192.168.1.32 to 192.168.1.63

IP address range for Router A to Router B serial connection _____ 192.168.1.64 to 192.168.1.95

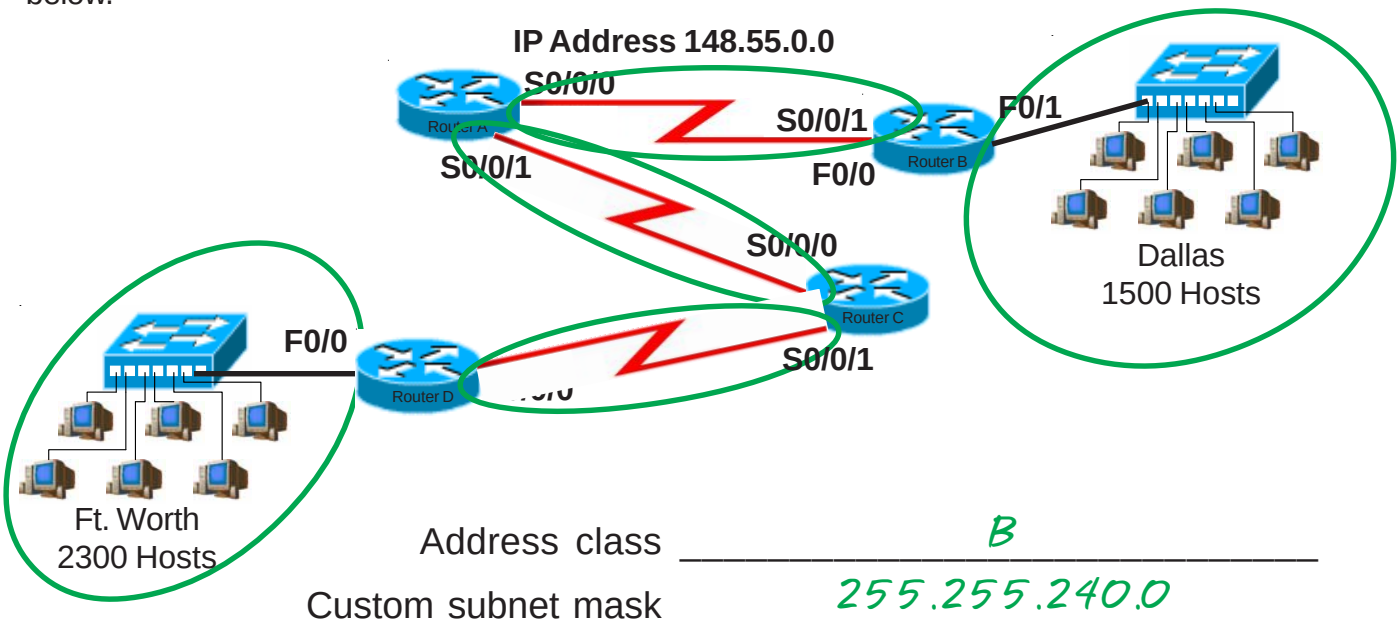
Show your work for <u>Problem 8</u> in the space below.

Number of Subnets	256	128	64	32	16	8	4	2	- Number of Hosts
	- 2	4	8	16	32	64	128	256	
	128	64	32	16	8	4	2	1	- Binary values
192.168.1.0	0	0	0	0	0	0	0	0	

(1)			0	192.168.1.0	to	192.168.1.31
(2)			1	192.168.1.32	to	192.168.1.63
(3)		1	0	192.168.1.64	to	192.168.1.95
(4)		1	1	192.168.1.96	to	192.168.1.127
(5)	1	0	0	192.168.1.128	to	192.168.1.159
(6)	1	0	1	192.168.1.160	to	192.168.1.1191
(7)	1	1	0	192.168.1.192	to	192.168.1.223
(8)	1	1	1	192.168.1.224	to	192.168.1.255

Practical Subnetting 9

Based on the information in the graphic shown, design a network addressing scheme that will supply the **minimum number of hosts per subnet**, and allow enough extra subnets and hosts for 15% growth in all areas. Circle each subnet on the graphic and answer the questions below.



Address class ___B___

Custom subnet mask ___255.255.240.0___

Minimum number of subnets needed ___5___

Extra subnets required for 15% growth + ___1___
(Round up to the next whole number)

Total number of subnets needed = ___6___

Number of host addresses in the largest subnet group ___2300___

Number of addresses needed for 15% growth in the largest subnet + ___345___
(Round up to the next whole number)

Total number of address needed for the largest subnet = ___2645___

Start with the first subnet and arrange your sub-networks from the largest group to the smallest.

IP address range for Ft. Worth ___148.55.0.0. to 148.55.15.255___

IP address range for Dallas ___148.55.16.0. to 148.55.31.255___

IP address range for Router A to Router B serial connection ___148.55.32.0. to 148.55.47.255___

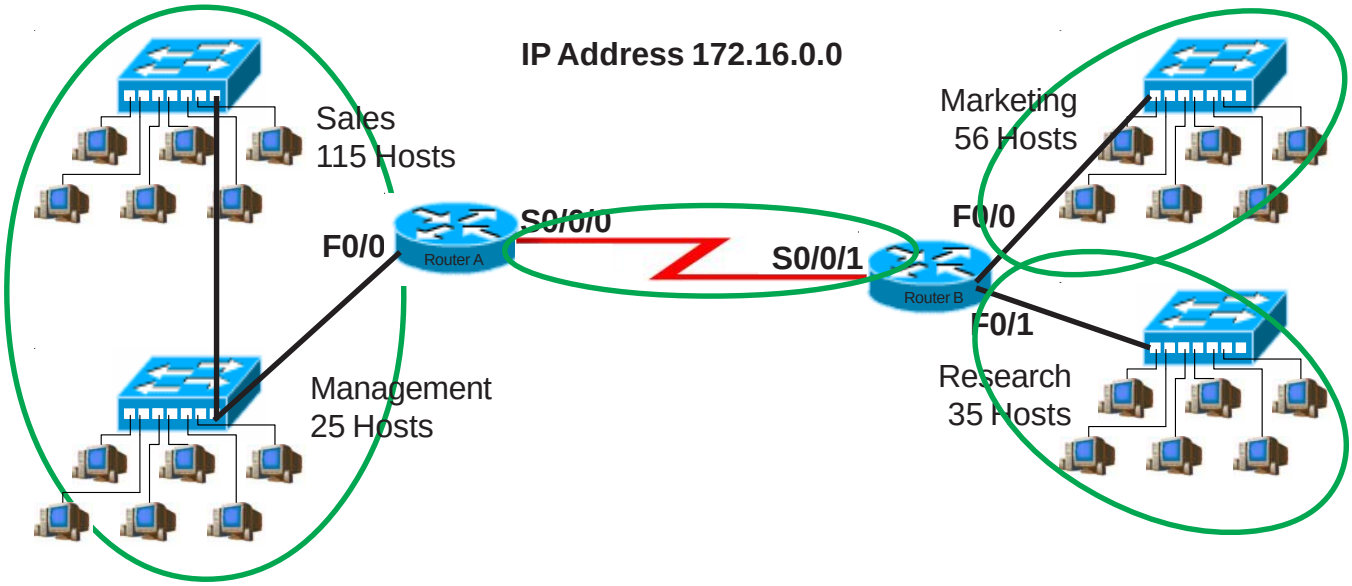
IP address range for Router A to Router C serial connection ___148.55.48.0. to 148.55.63.255___

IP address range for Router C to Router D serial connection ___148.55.64.0. to 148.55.79.255___

Show your work for <u>Problem 9</u> in the space below.

Practical Subnetting 10

Based on the information in the graphic shown, design a network addressing scheme that will supply the **minimum number of subnets**, and allow enough extra subnets and hosts for 110% growth in all areas. Circle each subnet on the graphic and answer the questions below.



Address class	B
Custom subnet mask	255.255.255.240
Minimum number of subnets needed	4
Extra subnets required for 110% growth (Round up to the next whole number)	+ 5
Total number of subnets needed	= 9
Number of host addresses in the largest subnet group	140
Number of addresses needed for 110% growth in the largest subnet (Round up to the next whole number)	+ 154
Total number of address needed for the largest subnet	= 294

Start with the first subnet and arrange your sub-networks from the largest group to the smallest.

IP address range for Sales/Managemnt	172.16.0.0 to 172.16.15.255
IP address range for Marketing	172.16.16.0 to 172.16.31.255
IP address range for Research	172.16.32.0 to 172.16.47.255
IP address range for Router A to Router B serial connection	172.16.48.0 to 172.16.63.255

Show your work for <u>Problem 10</u> in the space below.

Valid and Non-Valid IP Addresses

Using the material in this workbook identify which of the addresses below are correct and usable. If they are not usable addresses explain why.

IP Address: 0.230.190.192
Subnet Mask: 255.0.0.0
Reference Page Inside Front Cover

The network ID cannot be 0.

IP Address: 192.10.10.1
Subnet Mask: 255.255.255.0
Reference Pages 28-29

OK

IP Address: 245.150.190.10
Subnet Mask: 255.255.255.0
Reference Page Inside Front Cover

245 is reserved for experimental use.

IP Address: 135.70.191.255
Subnet Mask: 255.255.254.0
Reference Pages 48-49

This is the broadcast address for this range.

IP Address: 127.100.100.10
Subnet Mask: 255.0.0.0
Reference Pages Inside Front Cover

127 is reserved for loopback testing.

IP Address: 93.0.128.1
Subnet Mask: 255.255.224.0
Reference Pages 56-57

OK

IP Address: 200.10.10.128
Subnet Mask: 255.255.255.224
Reference Pages 54-55

This is the subnet address for the 3rd usable range of 200.10.10.0

IP Address: 165.100.255.189
Subnet Mask: 255.255.255.192
Reference Pages 30-31

OK

IP Address: 190.35.0.10
Subnet Mask: 255.255.255.192
Reference Pages 34-35

This address is taken from the first range for this subnet which is invalid.

IP Address: 218.35.50.195
Subnet Mask: 255.255.0.0
Reference Page Inside Front Cover

This has a class B subnet mask.

IP Address: 200.10.10.175 /22
Reference Pages 54-55 and/or Inside Front Cover

A class C address must use a minimum of 24 bits.

IP Address: 135.70.255.255
Subnet Mask: 255.255.224.0
Reference Pages 48-49

This is a broadcast address.

IP Address Breakdown

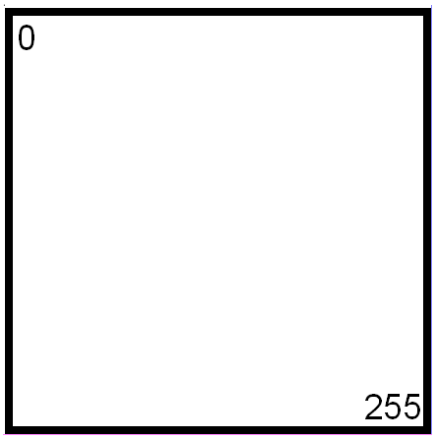
/24 8+8+8 255.255.255.0 256 Hosts	/25 8+8+8+1 255.255.255.128 128 Hosts	/26 8+8+8+2 255.255.255.192 64 Hosts	/27 8+8+8+3 255.255.255.224 32 Hosts	/28 8+8+8+4 255.255.255.240 16 Hosts	/29 8+8+8+5 255.255.255.248 8 Hosts	/30 8+8+8+6 255.255.255.252 4 Hosts
0-255	0-127	0-63		0-15	0-7	0-3
						4-7
					8-15	8-11
						12-15
				16-31	16-23	16-19
						20-23
					24-31	24-27
						28-31
				32-47	32-39	32-35
						36-39
					40-47	40-43
						44-47
				48-63	48-55	48-51
						52-55
					56-63	56-59
						60-63
		64-127		64-79	64-71	64-67
						68-71
					72-79	72-75
						76-79
				80-95	80-87	80-83
						84-87
					88-95	88-91
						92-95
				96-111	96-103	96-99
						100-103
					104-111	104-107
						108-111
				112-127	112-119	112-115
						116-119
					120-127	120-123
						124-127
	128-255	128-191		128-143	128-135	128-131
						132-135
					136-143	136-139
						140-143
				144-159	144-151	144-147
						148-151
					152-159	152-155
						156-159
				160-175	16-167	160-163
						164-167
					168-175	168-171
						172-175
				176-191	176-183	176-179
						180-183
					184-191	184-187
						188-191
		192-255		192-207	192-199	192-195
						196-199
					200-207	200-203
						204-207
				208-223	208-215	208-211
						212-215
					216-223	216-219
						220-223
				224-239	224-231	224-227
						228-231
					232-239	232-235
						236-239
				240-255	240-247	240-243
						244-247
					248-255	248-251
						252-255

Visualizing Subnets Using The Box Method

The box method is the simplest way to visualize the breakdown of subnets and addresses into smaller sizes.

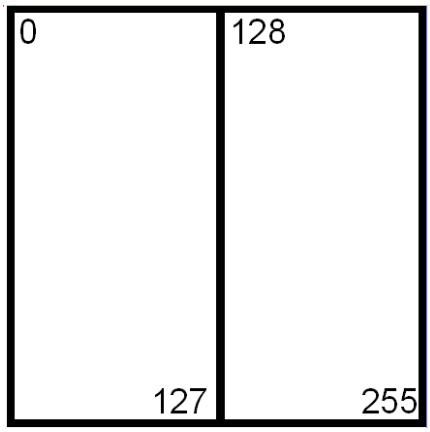
Start with a square. The whole square is a single subnet comprised of 256 addresses.

/24
255.255.255.0
256 Hosts
1 Subnet



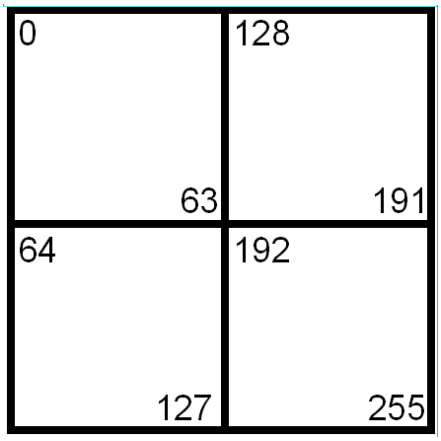
Split the box in half and you get two subnets with 128 addresses,

/25
255.255.255.128
128 Hosts
2 Subnets



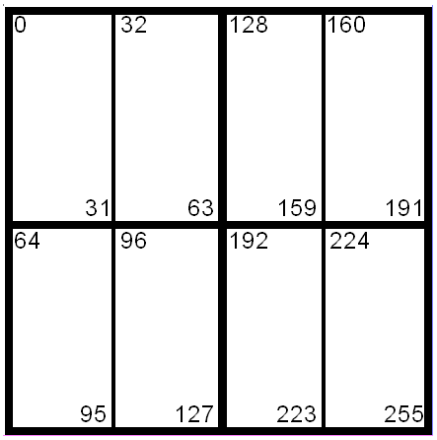
Divide the box into quarters and you get four subnets with 64 addresses,

/26
255.255.255.192
64 Hosts
4 Subnets



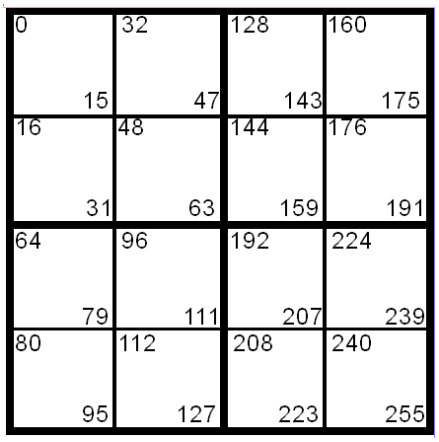
Split each individual square and you get eight subnets with 32 addresses,

/27
255.255.255.224
32 Hosts
8 Subnets



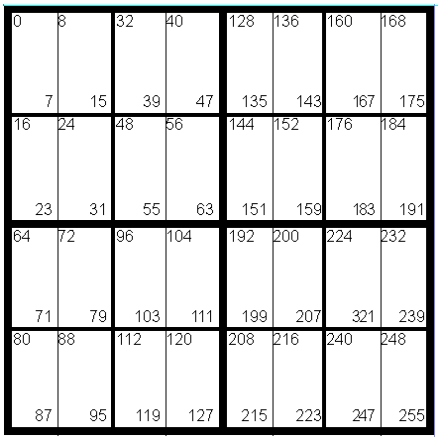
Split the boxes in half again and you get sixteen subnets with sixteen addresses,

/28
255.255.255.240
16 Hosts
16 Subnets



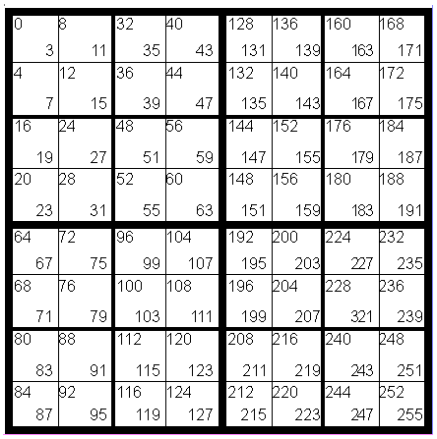
The next split gives you thirty two subnets with eight addresses,

/29
255.255.255.248
8 Hosts
32 Subnets



The last split gives sixty four subnets with four addresses each,

/30
255.255.255.252
4 Hosts
64 Subnets



Class A Addressing Guide					
CIDR	# of Bits Borrowed	Subnet Mask	Total # of Subnets	Total # of Hosts	Usable # of Hosts
/8	0	255.0.0.0	1	16,777,216	16,777,214
/9	1	255.128.0.0	2	8,388,608	8,388,606
/10	2	255.192.0.0	4	4,194,304	4,194,302
/11	3	255.224.0.0	8	2,097,152	2,097,150
/12	4	255.240.0.0	16	1,048,576	1,048,574
/13	5	255.248.0.0	32	524,288	524,286
/14	6	255.252.0.0	64	262,144	262,142
/15	7	255.254.0.0	128	131,072	131,070
/16	8	255.255.0.0	256	65,536	65,534
/17	9	255.255.128.0	512	32,768	32,766
/18	10	255.255.192.0	1,024	16,384	16,382
/19	11	255.255.224.0	2,048	8,192	8,190
/20	12	255.255.240.0	4,096	4,096	4,094
/21	13	255.255.248.0	8,192	2,048	2,046
/22	14	255.255.252.0	16,384	1,024	1,022
/23	15	255.255.254.0	32,768	512	510
/24	16	255.255.255.0	65,536	256	254
/25	17	255.255.255.128	131,072	128	126
/26	18	255.255.255.192	262,144	64	62
/27	19	255.255.255.224	524,288	32	30
/28	20	255.255.255.240	1,048,576	16	14
/29	21	255.255.255.248	2,097,152	8	6
/30	22	255.255.255.252	4,194,304	4	2

Class B Addressing Guide					
CIDR	# of Bits Borrowed	Subnet Mask	Total # of Subnets	Total # of Hosts	Usable # of Hosts
/16	0	255.255.0.0	1	65,536	65,534
/17	1	255.255.128.0	2	32,768	32,766
/18	2	255.255.192.0	4	16,384	16,382
/19	3	255.255.224.0	8	8,192	8,190
/20	4	255.255.240.0	16	4,096	4,094
/21	5	255.255.248.0	32	2,048	2,046
/22	6	255.255.252.0	64	1,024	1,022
/23	7	255.255.254.0	128	512	510
/24	8	255.255.255.0	256	256	254
/25	9	255.255.255.128	512	128	126
/26	10	255.255.255.192	1,024	64	62
/27	11	255.255.255.224	2,048	32	30
/28	12	255.255.255.240	4,096	16	14
/29	13	255.255.255.248	8,192	8	6
/30	14	255.255.255.252	16,384	4	2

Class C Addressing Guide					
CIDR	# of Bits Borrowed	Subnet Mask	Total # of Subnets	Total # of Hosts	Usable # of Hosts
/24	0	255.255.255.0	1	256	254
/25	1	255.255.255.128	2	128	126
/26	2	255.255.255.192	4	64	62
/27	3	255.255.255.224	8	32	30
/28	4	255.255.255.240	16	16	14
/29	5	255.255.255.248	32	8	6
/30	6	255.255.255.252	64	4	2